REPORT RESUMES

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A RESEARCH REPORT ON OPERATIONAL PLANS FOR DEVELOPING
REGIONAL EDUCATIONAL MEDIA RESEARCH CENTERS.
BY- CARPENTER, C.R. AND OTHERS
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THE NEED AND FEASIBILITY OF ESTABLISHING A NUMBER OF "REGIONAL EDUCATIONAL MEDIA RESEARCH CENTERS WITH A PROGRAMMATIC ORIENTATION" WERE INVESTIGATED. A PLANNING GROUP WAS ESTABLISHED TO SERVE AS A STEERING COMMITTEE. CONFERENCES IN WHICH GROUPS IN RESEARCH AND EDUCATION IN WIDELY DISTRIBUTED REGIONS OF THE COUNTRY PARTICIPATED WERE HELD TO DEVELOP AND TEST CONCEPTS AND PLANS. A SPECIAL CONFERENCE WAS HELD ON THE "REGIONAL CONCEPT" TO TEST ITS ACCEPTABILITY TO INSTITUTIONS OF THE MID-ATLANTIC REGION. RESOURCE PAPERS WERE GIVEN AND INFORMAL DISCUSSIONS WERE HELD WITH REPRESENTATIVE GROUPS AND INDIVIDUALS. DOCUMENTS WERE COLLECTED AND STUDIED. TWELVE AREAS IN WHICH RESEARCH WAS TO BE CONDUCTED AT THE REGIONAL CENTERS WERE DESCRIBED. SUGGESTED LOCATIONS, RESOURCES, PRINCIPLES, RESPONSIBILITIES, AND OPERATIONAL POLICIES WERE ALSO FULLY DISCUSSED. RATIONALES AND SUMMARY STATEMENTS CONCERNING OTHER ASPECTS OF PLANNING ARE INCLUDED. (HB)

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A RESEARCH REPORT

ON

OPERATIONAL PLANS FOR DEVELOPING REGIONAL EDUCATIONAL MEDIA RESEARCH CENTERS

by

The Division of Academic Research and Services
The Pennsylvania State University
University Park, Pennsylvania

April , 1962

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2. Conference with Representatives of National Agencies to Explore Strategies, Washington, D.C., January 10, 1962

Homer Babbidge, American Council on Education
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Meredith P. Crawford, Human Resources Research Office
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Howard E. Page, National Science Foundation
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3. Plan-Development and Evaluation Conferences

Stanford University, Palo Alto, California, January 29, 1962

John D. Krumholtz, School of Education
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University of Washington, Seattle, February 5, 1962

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Paul E. Fields, Department of Psychology
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Sol Saporta, Linguistics
George P. Horton, Department of Psychology
C.R. Carpenter, Project Staff

Southern California, Santa Monica, February 6, 1962

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Elias H. Porter, Systems Development Corporation
David Ryans, Systems Development Corporation
William Beals, Systems Development Corporation
C.R. Carpenter, Project Staff

Southern Regional Education Board, Atlanta, February 23 - 25, 1962

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John K. Folger, Dean, Graduate School, Florida State University
Carson McGuire, School of Education, University of Texas
R.F. Schenkkan, Director Radio & TV, University of Texas
Claude Purcell, State Superintendent of Schools, Georgia
D. Smith, State Department of Education, Georgia
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Kenneth Wilson, Southern Regional Education Board Staff
Ida W. Smith, Southern Regional Education Board Staff
Mary H. Smith, Southern Regional Education Board Staff

C.R. Carpenter, Project Staff
L.P Greenhill, Project Staff
T.P. Robinson, Project Staff

4. Independently Organized Plan-Development and Evaluation Conferences

University of Illinois, February 23, 1962

Gustav J. Froehlich, Bureau of Institutional Research
Nathaniel L. Gage, Bureau of Educational Research
J. Thomas Hastings, University Examiner
David M. Jackson, University High School
Robert W. Jones, Department of Sociology
Charles J. McIntyre, Coordinator of Instructional Television, Chairman
Edwin B. Parker, Institute of Communications Research
J. Richard Suchman, Associate Professor of Education

University of Minnesota, February 24, 1962

Russell W. Burris, Assistant Professor, General College
Daniel C. Neale, Assistant Professor of Educational Psychology
Alton L. Raygor, Student Counseling Bureau
Wallace A. Russell, Professor of Psychology
John E. Stecklein, Bureau of Institutional Research, Chairman

University of Minnesota, February 28, 1962

Chester Harris, Professor of Education, Chairman
Virgil Herrick, Professor of Education
Percy Tannenbaum, Mass Communications Research Center
Philip Lambert, Director of Laboratory School
Paul Eberman, Associate Dean of Education
Harry Harlow, Primate Research Center
L. Clinton West, Visiting Professor, Audio Visual Materials
Herbert Klausmeier, Professor of Education
Julian Stanley, Professor of Education
K.U. Smith, Professor of Psychology

5. **Conferences on Instrumentation**

Penn State Instrumentation Group February 8 and February 20, 1962

Otis Lancaster, College of Engineering, Chairman
Sidney Bowhill, Electrical Engineering Department
Robert Campbell, Engineering Graphics Department
Rupert Kountz, Civil Engineering Department
Richard Reich, Industrial Engineering Department
H.I. Tarpley, Electrical Engineering Department
Carl Volz, Electrical Engineering Department
Merritt Williamson, Dean, College of Engineering

6. **Conference to Test Feasibility and Acceptance of Plan in One Region**

The Pennsylvania State University, University Park, Pennsylvania, March 16-17, 1962

Robert Glaser, Department of Psychology, University of Pittsburgh
John Geise, Vice Chancellor, Regional Program, University of Pittsburgh
Charles F. Hoban, Jr., Annanberg School of Communications University of Pennsylvania
J.G. Brainerd, Moore School of Electrical Engineering, University of Pennsylvania
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John Barson and Robert W. Kilbourn, Wayne State University

Resource Memoranda

Jerome S. Bruner, Harvard University
Kenneth W. Spence, State University of Iowa

The Project Staff wishes to express deep appreciation to the above named people and to all of the others who have so willingly given of their time and thinking.

I. THE TASK

General Objectives

On November 15, 1961, The Division of Academic Research and Services entered into a research contract with the Educational Media Branch of the United States Office of Education under the provisions of Section 701, Part A of Public Law 85-864.

The general objective of this contract was to carry out a special research project which would investigate the need for and feasibility of establishing a complement of "Regional Educational Media Research Centers with a Programmatic Orientation". If the concept of the regional educational media research centers was found to be justified and feasible, the project would also develop operational plans and recommendations which would lead to their establishment.

Specific Objectives

The specific objectives of the research project as set forth in the contract were as follows:

" 1. To select a national sample of institutions of higher education, foundations, and trade and industrial organizations which are concerned with educational media research.

2. To determine through interviews and consultations:

   (a) Needs for research on educational media which are not being met currently through existing programs.

   (b) Resources available within the several regions of the United States for the conduct of programmatically oriented educational media research.

   (c) Additional resources and facilities required for the conduct of programmatically oriented research.

3. To develop recommendations relative to:

   (a) The appropriate number of programmatic centers and possible locations of such centers.

    (b) Conditions essential to the establishment of such centers.

    (c) Resources required for the operation of such centers.

    (d) Principles and policies for the operation of such centers.

4. To typify these recommendations through the development of plans for the initiation and operation of one pilot center encompassing:

    (a) Appropriate objectives.
    (b) Plan and scope of operation.
    (c) Means of assessing the effectiveness of the pilot operation.
    (d) Budget required for the support of the pilot center.

5. To make an initial test of feasibility of the plan by collecting evaluative comments from institutions and agencies in one or more service areas in which such a proposed center might operate.

6. To report findings and recommendations to the Office of Education."

II. PROCEDURES

The procedures adopted to obtain data for this study were as follows:

> A planning group was established to serve as a local steering committee. Conferences of several kinds were held for various purposes, but mainly to develop and test concepts and plans. Representative groups of people in widely distributed regions of the country participated. A special conference was held on the regional concept and for testing its acceptability to institutions of the Mid-Atlantic Region.
>
> Substantive resource papers and memoranda were solicited with a large percent of responses from outstanding individuals, well known for their interest in research on educational media and meaningful human learning.
>
> Informative reports were given and informal discussions were held with representative groups and individuals in various parts of the country.
>
> Relevant documents were collected and studied.

Each of these procedures will be discussed in the following sections.

A. Planning Group

A planning group of six individuals with a background of research and interest in educational media was established to serve as a local steering committee for the research project. The names of these individuals are listed at the beginning of this report. This group met from time to time to review progress and plan the next steps.

B. Conferences

Thirteen conferences were organized in different regions of the country. In these conferences an effort was made to explore a wide range of concepts and plans, and to test them critically. These conferences will be considered under several headings:

1. Initial Planning Conference
2. Conference with Representatives of National Agencies
3. General Exploratory Conferences
4. Independent Group Conferences
5. Conference on Regionality

The names of all conference participants are listed at the beginning of this report.

1. Initial Planning Conference

An initial planning conference was held at The Pennsylvania State University on December 4 - 6, 1961. The fifteen participants included representatives from industry, the Office of Education, the American Psychological Association, the National Academy of Sciences, and the project staff.

This conference was intended to be exploratory in an effort to formulate planning assumptions. It discussed such topics as: the magnitude of the educational enterprise in the United States; the present state of educational research; the need for a massive, sustained research effort in learning and education; the possible need for and functions of centers for research on media and learning; some examples of the application of the research center concept in other fields; the development of the idea of centers for research on learning; research on media vs. research on learning; the concept of regionality; the advantages and limitations of programmatic research as an addition to project grants research; availability of resources of various kinds, including manpower and funds; important research areas which might be investigated by programmatic centers; instrumentation and facilities for centers; possible location of centers for research on educational media and learning; and relationships of this plan to existing programs.

This conference was of considerable value in helping to shape the beginning conceptions and assumptions of the research plans.

2. Conference with Representatives of National Agencies to Explore Strategies and Inform Them about the Planning Project

The representatives who attended this conference at the American Psychological Association's Headquarters, Washington, D.C., January 10, 1962, were very familiar with the Washington scene and the research programs and plans of important agencies. The project director, assisted by Sherman Ross and Jack Edling, outlined the hypothetical plan and invited critical comments and suggestions for planning strategies. The conference accomplished the purpose of informing the participants of emerging plans being drafted for the U.S. Office and suggested possible alignments of interests in research on human learning.

3. General Exploratory Conferences

Stanford University:

Eight members of the faculty of Stanford University met with two members of the project staff at Palo Alto, California on January 29, 1962. This group was informed of the proposed characteristics of the research project and then discussion followed on such issues as the justifications for media learning research centers, the soundness of the general concept, relationship of a center to the universities of a region, criteria for locating centers, scope of operations, areas of research, needed facilities and instrumentation, etc.

Conference with Learning Specialists from Industry:

A second conference was held in Palo Alto, California on February 1, 1962 with six learning specialists from industry, one college representative and two members of the project staff. After the problem had been outlined, the discussion centered on possible industrial participation in centers for research on media and learning. The advantages and disadvantages of basing the centers at universities were also explored, as well as the requirements for sustained programmatic research.

University of California, Berkeley:

On February 2, 1962 two members of the project staff met in Berkeley with eight representatives from the University of California. After a preliminary briefing, the discussion dealt with such topics as: degree of emphasis on basic research in centers, regionality aspect of centers, what centers would do that is not being accomplished by present research grants program, graduate training in educational research, research areas, philosophy of centers, facilities, desirability of locating a center in the Bay Area, and the problems of selecting center locations.

University of Washington:

The director of the project met with thirteen representatives from the University of Washington on February 5, 1962, in Seattle. The topics discussed were: how to improve learning research significantly, the role of centers in attracting competent research people, staffing arrangements, important areas for research, and administrative arrangements as well as parallels with the Primate Centers development.

Southern California:

On February 6, 1962, the project director met in Santa Monica with three individuals from Systems Development Corporation and one from the University of Southern California. Representatives invited from the University of California at Los Angeles were unable to attend. Issues discussed included the systems approach to research on meaningful learning, the interdisciplinary nature of the staff required for research of this type, some significant problem areas for research, implementation of research findings, criteria for the location of centers, the scope of centers, and the possible roles of non-profit research organizations.

Southern Regional Education Board:

On behalf of the project staff, the Southern Regional Education Board organized a conference in Atlanta, Georgia on February 23 - 25, 1962. It was attended by nine representatives of educational institutions in the southern region, four members of the Southern Regional Education Board staff and three members of the project staff. This conference focused attention on the following questions: Are there real needs for Regional Media Learning Research Centers? How can such centers be justified in competition with other demands being made on common resources, pools of funds, people and institutions? What authorized funds could be used and what educational programs would benefit from the centers? What are some critical areas of research which involve complex learning and media (stimulus materials) which, if investigated with enough force, might yield very significant advances in education? In broad outlines, what should be the characteristics of a typical center, and what should be the number and the scope of the centers as reflected in size of funds, size of staff, facilities, etc. over the period of time, 1962 to 1970?

How should the centers be established and operated? Is the assumption of regionality desirable and practical? How should the national complement of centers be coordinated for planning and conducting programmatic research? Is it necessary (now and later) to request funds for buildings, facilities and instrumentation? Should the Southern Region develop a proposal, on an area basis, for a center or centers to be located in the South?

4. Independent Group Conferences

Individuals at the University of Illinois, University of Minnesota and University of Wisconsin were invited to set up one day conferences on behalf of the project staff. The groups were provided with copies of the project proposal and Appendix A of the contract, which defines the research task. They were asked to hold a free discussion and to report the proceedings to the project staff. A similar conference on instrumentation was held at Penn State. Participants are listed at the beginning of this report.

University of Illinois:

Eight faculty members of the University of Illinois met on February 23, 1962 under the chairmanship of C.J. McIntyre. Discussions ranged over the following topics: advantages of regional media learning research centers, kinds of projects a center might undertake, critical areas for research, the concept of regionality, characteristics of a learning research center, how it might be operated and administered, and problems of staffing, facilities and financing.

University of Minnesota:

At the University of Minnesota five individuals who were interested in research on human learning met on February 24, 1962. John E. Stecklein served as chairman. Topics discussed covered the following: relationship of media research and research on learning, research emphasis in proposed centers, staffing, location of a center, architectural considerations, and budget.

University of Wisconsin:

Chester Harris arranged a conference at the University of

Wisconsin on February 28, 1962 in which ten faculty members participated. Subjects discussed included: possible functions of programmatically oriented research centers, precedents for such centers from fields outside of education, relation of research centers to demonstration centers, communications research problems, needs for establishing centers, need for basic research, equipment and facilities, staff, national scope, scope of programs of individual centers, and need for continuing financial support.

Penn State Instrumentation Conference:

A group of engineers met at The Pennsylvania State University on February 6 and February 20, 1962 under the chairmanship of Otis E. Lancaster, to consider the types of instrumentation which would be useful for research on learning, currently available equipment, as well as some possible new developments.

5. Regional Conference at The Pennsylvania State University

In order to make an initial test of the feasibility of regional inter-institutional cooperation in the operation of a media learning research center a conference was held at The Pennsylvania State University on the 16th and 17th of March, 1962. The forty participants included representatives from thirteen institutions of higher learning in Pennsylvania, Delaware, New York, New Jersey, and Maryland. Representatives from several other colleges and universities were invited but were unable to attend. The university participants included individuals with backgrounds in educational and psychological research, and those responsible for the administration of research in their institutions.

In addition there were participants from regional electronic industries, textbook publishers, the Pennsylvania Department of Public Instruction, and a public school system. Representatives from the U.S. Office of Education and the Oregon Regional Educational Development Project attended also.

The conference centered around an exploration of justifications and possibilities of regional inter-university cooperation in a media learning research center for the Mid-Atlantic Area. An account of this important conference is given in Section VI of the report.

C. Resource Papers and Memoranda

A major source of valuable information was the resource papers and memoranda which were especially prepared by people who are well known for their work in media and learning research. Each individual was invited to prepare a 3000 to 5000 word paper organized around the following topics:

1. Justifications for establishment of regional learning research centers with a programmatic orientation 2. Scope of research programs. 3. Facilities and instrumentation. 4. Staffing, organization and administration. 5. Location of centers. 6. Financing of centers. 7. Summary statements.

Of the seventeen people invited to contribute, twelve sent papers or shorter memoranda. The names of the contributors are listed at the beginning of the report. The papers are reproduced in Appendix 2.

D. Reports and Personal Discussions

The director of the project and other members of the staff reported on the project to various groups and had personal discussions with many individuals.

Conference of Association for Higher Education, Chicago, Illinois:

An informative report was given to those attending the special meetings of Institutional Research Directors. Suggestions were made for cooperation and expressions of interest and criticism were invited.

Portland, Oregon:

Discussions were held with Lester Beck and Ralph Steetle, and a visit was made to the new Primate Center. Many concepts and ideas were discussed.

Salem, Oregon:

Discussions were held with Allen Lee, Director of the Oregon Planning Project for Regional Educational Development

Organizations. He reviewed accomplishments and objectives of planning as did C.R. Carpenter. The two plans were compared. It was agreed to exchange preliminary drafts of plans and to have future discussions at Chicago and Penn State. The plans were viewed as two parts of a complete program of research and development.

Seattle, Washington:

Discussions were held with Provost F.P. Thieme and Graduate Dean Joseph McCarthy of the University of Washington relative to possible uses of World Science Fair buildings for educational research and development purposes after the Fair has terminated.

Textbook Publishers:

A report of the project was presented to the Annual Management Conference of the American Textbook Publishers Institute, by Thomas P. Robinson at Cherry Hill, Pennsylvania, March 22, 1962.

Annual Meeting of Division of Audio Visual Instruction:

Several men on request by the project director agreed to report on developing plans to a DAVI special meeting at Kansas City on March 30th, 1962.

E. Other Documentation

The staff of the project made extensive efforts to gather together and study relevant documentation. These documents included studies of national goals, research proposals, reports of Federal agencies, reports of relevant conferences, etc. A list of these documents is included in Appendix 1.

III. NEEDS AND JUSTIFICATIONS FOR RESEARCH ON LEARNING

General Statement

Two questions should be answered: First, is the need and justification for greatly increased investments of resources and efforts in research on human learning of primary significance to education? Second, can research centers, as defined in this report, be justified as one additional means of expanding research, and for extending new knowledge, and can they be of significance in achieving the goals and purposes of education?

This study proposes that to achieve national goals, improved education is essential both as means and as a goal valued in itself, and that quality research is necessary for this improvement. It is reasoned:

1. That the management of learning is or should be the central concern of all education.

2. That the extension and improvement of education requires a large expansion of research to increase our understanding of complex human learning and its advancement.

3. That new efforts, beyond what has already been done and is now being done, are required to make a significant advance in our understanding of, and competencies for, the management of learning.

4. Finally, that a mature science of learning is needed to solve critical national problems of widespread concern to the government and to the people.

A. Needs for Increased Research in Education

Reviews of research literature (1), documents and policy statements (2), and the judgments of educational statesmen (3) either explicitely or by implication emphasize the need and justification for more and better educational research. For example, every national goal and program described by the members of the President's Commission on National Goals implies needs for extending and improving education. (Numbers in parentheses refer to cited references, p.110 ff)

Improving the quality of education requires a basic understanding and knowledge of complex meaningful human learning. The latter term may be defined as the development and management of adaptive behavioral changes, including the acquisition of intellectual skills and competencies. Education at all learning levels and achievements from infancy to adulthood, from motor skills to the work of creative genius, centrally involves the processes of learning.

The special literature which reviews the research on learning (4), conference reports of psychologists and other specialists in the area of learning and related subjects (5), assessments of needed research by Federal agencies (6), and the statements of those who contributed to this study from many disciplines, all vigorously support the need for greatly strengthened efforts in the field of learning research.

The urgency is not merely for more research, but for research of the highest quality, for different kinds and programs of research in depth on really important and therefore difficult problems. Such problems have not and cannot be attacked until new approaches, including greater amounts of support, have been developed.

1. Contribution of Learning Research to National Problems

Repeatedly, during the fact-finding, imaginative and searching conferences of this study, critical national problems were discussed. It was apparent that adequate learning research could make an important contribution to their solution. Samples of the more important problem areas considered follow:

a. The explosion of knowledge and the associated technological revolution which require that vastly more people during their lifetimes learn more information and acquire more skills than ever before in history.

b. The need, as society and culture expand and become more complex, to seek the highest levels of intellectual achievements and similarly to reach the highest levels of creative inventiveness and discovery.

c. The need for millions of people to extend formal and informal learning activity beyond school and college training, and indeed to continue learning throughout their whole life cycle.

d. The assessment of competencies, abilities and talents in individuals at all levels, and the provision of appropriately regulated and scheduled learning conditions for their fullest possible development.

e. Improvement of both the effectiveness and efficiency of educational and training materials, resources, methods, media, etc., which constitute the teaching and learning components in schools, colleges and universities. The needs to improve and extend the distribution of educational stimulation for large numbers of adults in their communities.

f. The problems of assessing and matching the characteristics of individual learners appropriately with materials to be learned and to provide continuity of learning over the full ranges of formal curricula and into continuing programs of informal study.

g. The development of new approaches to learning, new methods and new institutional arrangements as required to meet the new dimensions of problems that confront education in this and other countries.

h. The problem of greatly improving and expanding professional training in medicine, engineering, teaching and the technical areas.

i. The necessity of teaching people how to adapt to a rapidly changing society.

In addition to these broad and basic critical problems many other practical problems were stated by conference members: technological displacement and needs for rapid, effective retraining; the rapid antiquation of knowledge and skills; the problem of the deprived or handicapped child or person; educational problems arising from population and social mobility; the wastage of talents urgently needed in the economy; delinquency whether urban or rural; mental health; demands for education and training needed for national defense and security; needs for training for service in other countries and cultures; and the hard realities of economic losses and gains associated with educational inadequacies.

2. Recognition of Our Limited Knowledge about Learning

Scholars, philosophers and scientists who have thought most deeply about human learning as a natural phenomenon have recognized its complexity. The theoretical problems of memory or the persistence of learning over time, and the selectivity of learning both for retention and forgetting have puzzled the greatest of thinkers. Those who have considered these and related questions have been humble before the complexities of the problems.

Repeatedly, the scientific specialists from many disciplines, who have most carefully assessed the state of dependable knowledge about learning, have emphasized the great chasm between what is really known and what should be known to manage our educational enterprises intelligently. Their consciousness of the void is most apparent when they discuss the task of applying facts and principles about learning to the more complex problems of education. The men who know most about maturation rates of individuals for learning different kinds of content, the genetics of intelligence, mathematical models of learning processes, and the characteristics of stimulus materials, these men realize keenly the urgent need to know more than we do.

During recent years in conference after conference with psychologists, measurement specialists, theorists and other investigators at Easton (7) and Madison (8), at Northwestern (9) and Penn State (10), at Woods Hole (11) and Stanford (12), it could be observed that during the past 50 years many behavioral scientists actually have retreated from the difficulties of educational problems into their limited laboratories where relatively simple, controlled experiments could be conducted. Many of them have had neither the incentives nor the funds and research facilities to attack adequately the complex educational problems confronting society. Meanwhile, the educational activities of the nation have been operated and expanded without enough help from the scientists of learning or others with similarly high competencies.

Why has this been true? The needs for a science of human learning have not been fully understood. Encouragement and support for this field have not been equated with its real importance. Relative to the status of other scientists, those working on learning problems, and most especially on complex realistic educational problems, have lacked recognition and professional esteem. A developed science of learning may correct some of these conditions.

In contrast to this attitude is the widespread belief that every educated man knows enough about the field of learning to make the crucial decisions about educational policies and practices. Too often, men distinguished in one particular field of knowledge have acted with cavalier irresponsibility in making judgments upon complex and subtle problems relating to fundamental learning processes. The presumption of knowing more than is actually known, but less than should be known, has short-circuited the necessary sequences of events for defining the general problem, appropriately investigating it, then solving it and validating the results, and finally applying the results in practical educational situations.

Governor Leroy Collins (13) in reviewing the needs of higher education said,

> " Perhaps the greatest need of all is for more research into education, itself.
> We know too little about the learning process, and it is unfortunate that not more of education's genius has been devoted to finding out how the human mind learns and reasons and creates."

3. Research on Instructional Materials Production

One of the most important developments which relates directly to the improvement of the quality of American education is that represented by the Physical Science Study Committee, the Mathematics Study Group and the Course Development Project of the American Institute of Biological Sciences. These efforts involve the re-organization of "blocks" of knowledge for learning, innovations of instructional methodologies and the production of combinations of instructional materials including texts, resource books, study guides, new laboratory manuals, tests, project outlines, films and other appropriate stimulus materials.

Other developments that should be noted are the instructional productions of the National Educational Television and Radio Center, the Continental Classroom Series and the Mid-West Airborne Instructional Television Project.

These developments appear to be the beginnings of other similar programs that will be undertaken not only in the sciences and mathematics but also in engineering, languages, the behavioral sciences and the humanities.

It can be predicted that concentrated efforts of groups of distinguished content people on systematic work to improve instruction will be increased and will be extended over wide ranges of the curricula including those of higher education. Furthermore, these efforts may importantly affect education on a nationwide basis and for many millions of students.

The specialists consulted during this study were keenly aware of the developments referred to above and they were also aware of their future possibilities for improving the quality of education. Time and again it was proposed that projects like those listed, as well as the great educational enterprises of the publishing industries, should have strong and continuing support from learning research and development centers such as those being proposed in this report. There was strong and unanimous approval of the propositions (a) that the development of new courses and curricula of instruction, involving improved methodologies and the effective production of instructional materials, should be based on the applications of known facts and principles about human learning, communications theory and knowledge of the media, and (b) that research and development on learning should be an integral part of the production, evaluation and use of instructional materials of many kinds.

B. Development of a Science of Human Learning

1. Importance of Developing such a Science

Basic research is needed on a wide range of subject areas listed elsewhere in this report (pp. 40-44). There are few short cuts to the building of any science; building a science of learning is no exception.

What is required? "Admission of ignorance may be the beginning of knowledge." The needs for a science of human learning must first be recognized. Purposive planning must follow. The building of such a science in a democracy will require the convictions of many people, especially of responsible leaders and representatives, as to the needs for such a development and a realization of its possible values.

The field of learning research must attract and challenge our highly competent investigators. These scholars must be provided with adequate rewards, including social approval for their achievements. They must be provided with the resources necessary for the building of a science; they must also be provided with the instruments needed to solve the problems they attack. They must steel themselves to tolerate discouragement and disappointment and to persist purposively, regardless of failures or success, to solve ever more complex problems. In short, competent men must be encouraged to commit themselves to a dedicated effort which will extend over generations.

The building of a science of learning adequate for the arts of education will require massive and sustained support of resources and of men.

The relation of the science of learning to education can be similar to the relation of mathematics, physics and chemistry to engineering. The theory of mathematics and the physics of crystals preceded the development of transistors and their wide use to replace electron tubes in engineering developments.

Another point often made in the discussions of the present study was that basic theoretical results are not enough. The opinion was often expressed that the gap between general theories and principles of learning and experimental findings, and their applications to meaningful human learning must be bridged. The results of basic learning research must be applied, and quickly, in classrooms, studios, laboratories and in the display screens of the electronic media or the print of a book. The need for intermediate stages of research between the basic and applied levels, including developmental programs, and applications to the practical world of education was emphasized.

An important additional concept was developed. New, systematic strategies of research need to be developed to ensure that research results flow rapidly and effectively from experimentation through the various stages of proof and testing, adaptations, and variations to the places of application. The child learning mathematics, language or history, the college student learning philosophy, logic and ethics, or the adult learning the flood of new information and skills increasingly required in his field of work can profit greatly if research results are brought to bear on his learning problem.

Similarly, it was proposed that new strategies of knowing, accepting and applying the science of learning in education must be developed. Then, the two new patterns should be interlocked. Both new strategies must be developed to ensure a flow of results from the idea, or hypothesis, through different stages of research to the application on the learning behavior of individuals.

2. Place of Educational Technology

The critical problems of education have created great stirrings throughout the country. A technology of education is developing rapidly. Advanced electronic systems engineers who have participated in the conferences have described the exciting possibilities, present and future, of computer-regulated learning.

The media field is witnessing innovation on a hitherto unparalleled scale. Audio and video media are being introduced and tested in hundreds of ways. Methods and procedures are being changed. Educational facilities are being studied and re-designed. Teaching machines in many different forms are being made by the hundreds and are being introduced into schools. The use of television is increasing. Thousands of language laboratories have been installed in schools and colleges. Textbook publishers are anxiously assessing the trends of developments of educational technologies. They seek to read the signs of the times in order to chart a course for their great industry which is so closely related to education.

Truly we are in a period of revolutionary changes in technology as applied to education. We need to know how to manage and use this significant development for the right purposes.

The rapidly developing technology of education urgently requires for its wise management and application a thorough understanding of the nature and conditions of complex learning. What is already known, however limited, about perception, cognition, intellectual development, transfer of performances and concepts, the emotional components of learning, motivation, etc., should be objectively and systematically assessed and formulated so as to be useful in guiding and shaping new educational technologies.

The same requirement exists for a well established medium, such as print, which has been taken for granted. Repeatedly during this study, learning specialists and those who know the instructional media best, proposed extended research in depth on print. Printing and speech, live or recorded, will continue to be used predominantly in instructional communication systems.

Relative to the nature and use of the written word , one authority stated that,

> " . . . it is a topic that is at the heart of the education process and that the nature of written language is only dimly understood and that the nature of reading is even less well comprehended. In view of this critical state of ignorance, it is the more surprising that there does not exist a single major research center in the United States addressing itself directly to the study of written language, either from the point of view of its encoding process in writing or its decoding process in reading." [1]

What is said here about the written word applies with equal validity to speech, languages, mathematics, pictorial and graphic symbols and other stimulus materials.

3. Relation of Media and Learning

The revolutionary development of advanced educational technologies is urgently needed by the people of this nation. The development should be encouraged, supported and made the servant of deserving educational purposes. To accomplish this objective, extensive new research is needed beyond the amounts and levels now being achieved.

Judgments given by many authorities who contributed to this study support this conclusion. There were no contrary judgments. However, every discussion of the relation of learning and media pointed to the conclusion that significant and productive research on the media-learning systems of materials and activities must include other essential components:

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[1] See Resource Memorandum by J.S. Bruner, Appendix 1, page 252.

a. The organization and content of the knowledge

b. Methods and procedures for instruction and learning

c. The characteristics of the learners

d. Sources, authorities and teachers

e. Characteristics of the learning environments.

It was generally agreed that research on the media, or even the whole technology of instruction, must first focus on learning processes. Without such a focus even strong research programs, limited to instructional media alone, will not produce the greatest possible yield of important results.

To achieve its true potential, the technology of education, including the media of all kinds, must be based on an emerging science of learning. Between all the sciences and technologies, including those of education, complex interactions exist. Generally, consultants to the study believe that although reciprocal interactions occur, scientific developments precede technical developments. A science of human learning should therefore be built to support and authenticate a technology of education. The educational technologist or specialist working without knowledge of learning is like the engineer searching for oil without knowledge of geology and geo-physics, or like the practicioner of the medical arts working without knowledge of anatomy and physiology. The general case, then, is that a science of a field of human endeavour is basic to the technologies of that field.

This line of thought can be further extended. The responsible people in schools, colleges and universities work in the area of the practical arts. They plan and execute programs of instruction; they select instructional materials including textbooks. They design schedules, select and employ teachers; they administer systems and institutions. Usually they guide their institutions toward some general purposes. They evaluate results. They are, in brief, practicioners of the arts of education. In all these activities they need continuously the information from a full range of research activities, developmental programs and practical experiences.

It is suggested that as educational problems become more complex and critical, as the needs for precision of decisions and actions increase, correspondingly the accumulated common knowledge of tradition and practical experiences must be more and more strongly supplemented with reliable evidence, systems of objectively derived facts, and experimentally derived principles. Fulfilling these latter functions is the role of a science of learning.

Many people consulted during this study observed that there seem to be necessary divisions of labor among those responsible for basic learning research, for intermediate levels of research, for the application and testing of research results and models, and lastly, those practical educators responsible for introducing results into our educational systems.

It was also repeatedly observed that the necessary experimentation on many kinds of learning problems can rarely be conducted by the people who must discharge their heavy responsibilities for the operations of education. It was further observed that most of the activities of practical educators that are termed experimentation or research, do not meet the minimum criteria for either experimentation or research. The necessary divisions of labor, however, impose another requirement, namely, close mutual cooperation and effective communication all along the line, from the people who are working at the basic levels on theories and problems of learning, over the intermediate stages to the practical educator, the administrator, the business manager, the teacher and indeed to the students themselves.

4. Limitations of Present Short-Term Grants and Contracts

The advantages and disadvantages of individual projects, programmatic research, and center-based research are well known to research administrators and need not be reviewed here in detail. After granting the advantages of project research, participants in this study pointed to the following limitations of this approach, all of which stress the need for sustained programs:

1. Competent, established investigators feel that much time which is spent preparing proposals could be spent more productively in the actual conduct of research.

2. Working with the support of small, periodic,and discontinuous grants makes it most difficult or even impossible to develop and retain a "core" staff of competent research people.

3. Small grants or contracts - - - up to $ 150,000 - - - can neither provide nor justify the essential buildings, facilities and instrumentation and generally these are not available in universities.

4. Small periodic grants and contracts do not usually correspond to the resources that are needed for effectively attacking the most important and complex problems of learning and related media. Therefore, the easy and more limited problems are selected, per force, which match the estimated funding possibilities.

5. The partial, incomplete and often unrelated results of project research, using varieties of non-comparable methods, do not add up to significant amounts of new information. The results are usually scattered and lack coordination and summated systematic patterns. [See summaries and abstracts of Title VII Projects, by Norberg (15) and VanderMeer (16).]

6. When project research produces results in the form of new hypotheses, leads and suggestions for continued research, these often cannot be pursued further by their discoverers.

7. Competitive procedures normally used in the preparation, selection and award of grants tend to create attitudes among applicants of proprietary rights to ideas, exclusiveness about research possibilities, and accordingly restrict the free exchange of ideas which is an essential condition for productive academic research.

8. The extremely difficult task of evaluating and selecting project proposals to be supported introduces powerful influences on the directions which research takes.

In spite of these limitations, no strong opinions were expressed for reducing the small grants programs or indeed of substituting for them programmatic, center-based research. The stimulus which small grants give to the development of interests and competencies in the field, the providing of research opportunities for individuals and small groups throughout the country, and the exploratory functions made possible by limited grants all amply justify their continuance and expansion.

Interviews, conferences and resource papers strongly supported the view that complementary or supplementary efforts in research on meaningful human learning are not only desirable but essential if the knowledge and understanding of complex learning are to be significantly increased and many critical educational practices improved.

This view usually answered comments suggesting that continuing and expanding present research practices alone would be adequate. Nevertheless, it is estimated that about 10 - 15% of the people with whom discussions were held would be satisfied with Federal and foundations'grants programs on three conditions: 1. That the amounts of grants be increased, even doubled or tripled; 2. That the grants be continuous or sustained; 3. That individuals be given complete freedom to do research on the problem they are working on now or on other problems of their own choosing.

Clearly, there are merits in these suggestions which research funding agencies might well consider. Indeed, the alternative procedure of providing sustained grants for specialized programmatic research was seriously considered as a next step in supplementing small project grants. For those who have not yet conceived of regional learning research centers and evaluated their possible advantages and limitations, plans for greatly increased funds for programmatic research are acceptable and urged. Frequently, discussions explored possibilities of combining specialized programmatic research efforts with regional centers. The general plan for centers presented in a later section reflects the suggestions for combining programs of research with regional centers.

C. The Research Center Approach

One approach to the solution of the research needs (described on pages 13 ff) which has been applied in other fields and has been suggested from time to time for educators, is the establishment of a series of learning research centers with sustained support. This possibility was spelled out in a report of a conference sponsored by the Office of Education at the Center for Advanced Study in the Behavioral Sciences at Stanford University in 1959. The following statement is taken from the report of this conference which was entitled New Teaching Aids for the American Classroom. (12)

> "A promising possibility would be to build, institutionalize and insure the continued operation of several educational communications research centers. . . . They should be appropriately housed and well equipped with the special apparatus systems which are essential to high quality and advanced research on communication processes and problems related to education. For each center an adequate core staff should be built, trained and developed. The members of the core staff should have permanent tenure and assurances of continuing support by the host institution, by foundations and federal agencies in order to be able to conduct systematic and programmatic research. By planning and agreements the centers could investigate different phases of basic general problems in depth and could undertake special projects appropriate to the interests of personnel, facilities, populations and the geographic location."[1]

It was this statement which led to the proposal for the present project.

1. Support for the Concept

The conference notes, resource papers, letters and memoranda demonstrate extensive support and enthusiasm for the development of research centers which could launch a sustained and massive attack on problems of education at all levels. The development of the concept in this study began with the assumption that the centers would have the characteristics named in the Appendix to the Contract (See Task, pp. 3-9) and as elaborated by the first exploratory planning conference. Subsequently the groups, usually after an informative and "warm-up" period, typically began to expand and elaborate the need and justifications for such centers, the research areas that could be investigated, what their full range of characteristics would be, the kinds of buildings and facilities that would be needed, costs and financing procedures, etc. In addition, many conference group participants or authors of resource papers developed arguments for the establishment of a center in their region or university.

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[1] C.R. Carpenter in New Teaching Aids for the American Classroom, Institute for Communications Research, Stanford University, 1960, p.91

Most of the groups and resource papers critically discussed the potentialities and difficulties of center-based, regional and programmatic types of research efforts. Examples of research centers in other fields were often described as "models" that could be followed.

The limitations or disadvantages that were stated one or more times and possible solutions that were offered are exemplified by the following statements:

a. Problem: It would be difficult to staff centers. Suggested solution: A build-up period of two or three years would be required. A beginning should be made in 1962 with two or three centers and these should be increased to an adequate number of optimal size over a period of 3 - 5 years.

b. Problem: It will be difficult but of crucial importance to find competent directors for the centers. Possible solution: A number of competent people have expressed interest in forming centers.

c. Problem: The centers will attract the most competent research specialists in learning and media and leave some colleges and universities with less competent faculties than they have now. Possible solution: This condition may be corrected eventually if centers have strong associated graduate and post-doctoral training programs.

d. Problem: University-based centers will lead to more concentration of competent investigators in a limited number of places than at present.

Possible solution: Regional cooperation may help correct this condition.

e. Problem: It will be difficult to keep the centers alive, creative and productive. Possible solution: To arrange for a flow of new people, especially graduate students, from universities through the centers.

f. Problem: If the centers are based in or at universities they will not be as productive of research results as if they were set up independently of universities. Universities have too many rules, regulations and restrictions. They are not responsive enough to the issues and problems of public and general education. The centers will require salary scales that would disrupt those of colleges and universities. Academic people in their institutions cannot effectively keep to planned schedules of research programs.
Suggested solution: These comments were made by people conducting research on learning who are associated with industries or non-profit research organizations. The majority of opinions of all individuals and groups was, nevertheless, that the centers should be university-based for reasons that will be stated later. (See pp.72-74)

g. Problem: The really important and creative research has been done by individuals working alone often under very severe disadvantages and adverse conditions. Possible solution: Research grants to individuals should be continued but complemented by programmatic research.

2. Integration with Regional Educational Development Organizations

Two plans are currently being developed - one for Regional Learning Research Centers and one for Regional Educational Development Organizations. The preceding statements tend to support the soundness of the decision of the U.S. Office of Education, the Title VII Staff and its Advisory Board to contract for both plans at the same time. This decision reflects the need for differentiation of responsibilities and at the same time calls for strong new developments to improve the quality of American education.

Extensive discussions between the responsible planning groups of the Oregon State Department of Education and The Pennsylvania State University led to agreements that the two plans when put into effect should be mutually supportive. The Southern Regional Education Board - Atlanta Conference, the Park Ridge-Chicago Conferences, and the last Penn State Conference generally approved this understanding. Mature thought leads to the view that the Regional Learning Research Centers, to be described in detail in the next section of this report, and the Regional Educational Development Organizations being planned by the Oregon group are integral parts of a necessary major effort to improve significantly the quality of education in the United States.

D. Present Allocation of Federal Funds for Research

From the report entitled Federal Funds for Science X[1] the following modified definitions which approximately reflect conventional usage in Federal agencies (NSF Report X, p. 62) will be used in this study:

> Research is systematic, objective and intensive study directed toward increasing knowledge and control of the subjects and processes investigated. Such work includes both basic and applied research.
>
> Basic research is that type of investigation which questions theory and present knowledge, searches for new theories and knowledge and continuously reorganizes and increases the validity of basic knowledge.
>
> Applied research is the activity of using basic knowledge for re-structuring or reformulating it for the purposes of improving or developing new models and prototypes for practical applications.
>
> Development is the systematic use of practical scientific knowledge directed toward the production of useful materials, devices, systems, methods or operations, including the design, development and improvement of operations and practices.

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[1] Federal Funds for Science X, National Science Foundation, NSF 61 - 82, United States Govt. Printing Office, Washington, D.C., 1962. Also listed in References (14).

1. Research and Development

This section surveys the amounts of funds for research and development assigned in areas of interest to Federal departments, offices and agencies.

It is expected that total Federal expenditures for research and development, and for implementing the construction of buildings and facilities, will be $ 10.8 billion for fiscal 1962. This sum represents a 22% estimated increase over expenditures for 1961 which were $ 8.8 billion.

The budget categories used do not permit analyses which show the amounts of funds spent on the science of learning. However, it is known that some of the listed categories of expenditures are in fields that contribute to the science of learning and the advancement of the quality of education. It is also known that almost every Federal department which has large research expenditures is supporting some basic and applied research related to learning, training and education. Clearly, however, the emphasis is on applied research and development.

Expenditures for basic and applied research for 1961 but not including development are reported as follows:

Department of Defense (Total research funds)	$ 872 million
Department of Health, Education and Welfare	$ 432 million
National Aeronautics and Space Administration	$ 392 million
Atomic Energy Commission	$ 229 million
Department of Agriculture	$ 165 million
National Science Foundation	$ 77 million
Department of Interior	$ 67 million
Federal Aviation Agency	$ 7 million
Other agencies	$ 54 million

Of the total amount of funds spent for research (basic and applied) and development, 30% is spent for research and 70% for development. Note: The U.S. Office of Education should consider establishing a policy guideline for its long-term programs for investing about the same proportions of total funds in research (basic and applied) and in development as the average for all other agencies, namely, 70% for development and 30% for basic and applied research on learning.

Probably funds of all agencies obligated for research in the psychological sciences may be taken as an indication of support for fields of research most closely related to research on learning. "Obligations for research in the psychological sciences were $ 38 million in fiscal 1960; they were estimated to be $ 42 million in 1961 and to increase to an anticipated $ 50 million in 1962." (National Science Foundation Report, X p. 20.) The National Science Foundation Report states that these funds are concentrated in Health, Education and Welfare (including the U.S. Office of Education), the Department of Defense and the National Science Foundation. These agencies obligated almost $ 40 million for research in the psychological sciences in 1961. The processes of learning are basic to many of the research areas supported by these funds.

Assuming that the science of learning is interdisciplinary and that the social sciences contribute to knowledge about complex human learning, then the obligations of research funds to anthropology, economics, sociology and other social sciences should be noted. Funds for these areas are expected to reach $ 70 million for the fiscal year 1962.

The United States Office of Education is reported to estimate total expenditures for research and development (National Science Foundation Report X, p. 98) to be $9,316,000 of which $ 3,240,000 is listed as the sum supporting basic research. Assuming that the remainder is support for development, although figures were not listed, the amount estimated would be $ 6,076,000 for development.

The budgets and operations of all Federal agencies, including the U.S. Office of Education, would need to be analyzed in detail to a degree of thoroughness beyond that of the National Science Foundation Report X in order to determine the amounts and proportions of Federal funds invested in basic research, applied research and development related to the areas of the science of learning as defined in this document. This could not be done in the time available.

However, several general observations and inferences will be made in the following section.

a. Observations and Inferences

From the above information it is concluded that:

(1) The majority of funds, perhaps as much as 80 - 90%, are spent on developmental work.

(2) Of the 10-20% spent on research, more than half is spent on applied research.

(3) It is probably correct to conclude that less than 5 - 10% of research budgets is invested in basic research defined as the search "for new knowledge".

(4) The estimated general trends and proportions of these figures for the U.S. Office of Education probably indicate even higher proportionate expenditures for developmental work.

(5) Other Federal agencies are increasing expenditures and initiating new programs related to learning research at a much more rapid rate than the U.S. Office of Education.

(6) No Federal agency has adequately initiated and taken the leadership for conceptualizing, planning, strengthening, building and implementing a science of learning supportive of the arts and practices of education. Response to this opportunity and this challenge could be made most appropriately of the United States Office of Education and/or the National Science Foundation under authority granted to them.

The conclusion is suggested that whereas strong support is given in an area of need as a national policy, the need for strong support in the area of human learning and education is grossly neglected. This fact is being realized and the U.S. Office of Education has an extraordinary opportunity at this time to exercise leadership in a cooperative effort.

The "generic" plan for establishing and sponsoring the operation of a national complement of learning research centers, to be described generally in Section IV of this report (p.66 ff.), is one desirable and feasible approach which can be recommended.

2. Research Centers in other Areas of Investigation

Another approach to the justification for greatly expanded Federal support of research and development on learning is to show how liberally funds have been made available for other areas of research of similar importance to that of human learning. Again and again during discussions, individuals cited Federal research programs, adequately supported and wisely administered, which are in striking contrast to the extremely limited and inadequate support provided for learning research.

The precedent for the Federal government to acquire land, construct buildings, and provide facilities and instrumentation for research programs has been established. For example, expenditures by Federal agencies for these purposes are reported as being in millions of dollars: $528,$650 and $984 millions for 1960, 1961, and 1962 respectively.

The amounts of funds committed for research and development plants are increasing rapidly. The National Science Foundation is "expected to obligate $ 60 million for research and development plants in fiscal year 1962." This figure compares with $ 13 million in 1960 and $ 19 million in 1961. The funds provide basic research facilities to develop and improve graduate research laboratories at colleges, universities and other institutions. Funds provide facilities for specialized biological areas, computer research, nuclear research, geophysics, oceanography and meteorology.

The Department of Health, Education and Welfare is expected to spend $ 47 million for research and development plants in fiscal 1962. Included are grants to assist in construction and procurement of facilities for health-related research. In this case the amount of grants cannot exceed 50% of the cost of such construction and facilities.

When an adequate need for research and development which is in the national interest exists and when this need cannot be met by existing facilities and programs, Federal policy appears able to take the actions necessary to accomplish the research including the building of research and development facilities.

Many examples can be cited in which Federal agencies have supported the construction, equipping and operation of research and development centers, similar in purpose and functions to those required for the proposed regional learning research centers.

The following is a list of well known examples of centers, laboratories or organizations established by Federal agencies in cooperation with universities:

Department of the Army

Army Mathematics Center - University of Wisconsin
Control Systems Laboratory - University of Illinois
Human Resources Research Office - George Washington University

Department of the Navy

Applied Physics Laboratories - Johns Hopkins University and the University of Washington
Naval Biological Laboratory - University of California
Ordnance Research Laboratory - Pennsylvania State University

Department of the Air Force

Lincoln Laboratory - Massachusetts Institute of Technology
Physical Research Laboratory - Boston University

Atomic Energy Commission

Argonne National Laboratory - University of Chicago
Biomedical Projects - UCLA and University of Rochester
Lawrence Radiation Laboratory (Livermore Laboratory), and
Los Alamos Scientific Laboratory - University of California

National Aeronautics and Space Administration

Jet Propulsion Laboratory - California Institute of Technology

National Science Foundation

National Astronomical Observatory - Association of Universities for Research in Astronomy, Inc.
National Radio Astronomy Laboratory - Associated Universities, Inc.

(Note: These are examples of research administered and conducted by an association of universities. Another example is Brookhaven National Laboratory.)

Other examples were frequently cited by conference participants such as the National Network of Agricultural Experiment Stations and Agricultural Regional Programs, and the Primate Centers which are being established by the National Heart Institute. Three of these "regional" primate centers have been approved and are being constructed at Portland, Oregon; Seattle, Washington; and Madison, Wisconsin. Additional centers and a National Primate Station are being planned. Reviews of plans for the Primate Centers and a site visit to the Oregon Center suggested some of the characteristics which will be included in "generic" plans for proposed regional learning research centers.

In conclusion, it should be pointed out that the NSF publication, Federal Funds for Science X (14), in a footnote on page 79 of the report, estimates that of the $ 10.8 billion assigned by all agencies for 1962, expenditures will be as follows: $3 billion for research, $6.7 billion for development, and $1 billion for research and development plants.

E. Areas of Research for Regional Learning Centers

The main justification for the expansion of research on meaningful human learning, and especially the justification for using the regional research center programmatic approach, should be in terms of the importance of areas of research which are especially appropriate for such expansion and for such centers. Also, the research areas should be those which cannot be feasibly and productively attacked by short term projects.

The conferences, resource papers, and documents define a great number of research areas. The research areas which fulfill these requirements are of special interest. A selection of the most important and promising areas are briefly described below:

Area 1. Analysis and Dissemination of Existing Knowledge

Conduct systematic and thorough analyses and assessments and make formulations and abstracts of the literature and information of the science of learning. Conduct critical, realistic tests of principles and facts which are judged to have enough validity for testing, and recommend proven results to educational development organizations and other appropriate groups. Determine the ranges and limits of appropriate applications and, while seeking dependable knowledge, establish criteria for determining the reliability, validity, adequacy, generality and usefulness of such knowledge. Finally, establish adequate methods for assessing new knowledge on meaningful learning as it is generated and apply them continuously.

Area 2. Measurement and Experimental Design

Investigate and develop theories, methods and procedures for the quantification of information on learning processes to high levels not yet achieved. Involve advanced theorists, mathematicians and statisticians in studying and improving relevant measurements and experimental designs needed in research on learning and in the management of educational enterprises.

Area 3. Acquisition, Retention and Transfer

Investigate by appropriate and adequate methods all factors which determine the amounts, kinds and rates of learning and the proficiencies of individuals for mastering "blocks" of knowledge and for acquiring complex intellectual skills. Conduct research on factors which determine the endurance of acquired knowledge and skills, and their transfer or generality of applications; and investigate the personal "life history" and environmental variables which generally have positive or negative effects on human learning.

Area 4. Learner Characteristics

Investigate analytically and in combination the personal characteristics of individuals and the conditions of learning which affect the intellectual behavior characterized by originality, creativity, "critical analysis" and other variabilities of learning responses. Relate these findings to general and special abilities and to maturation. Study conditions which produce conformity and stereotyping of thinking, intellectual performances, decisions and behavioral adjustments.

Area 5. Stimulus Materials (Media) and the Structure of Knowledge

Investigate systematically the stimulus and perceptual requirements of the media, modes and information displays, either extant or possible, which can be used singly or in combination for presenting, regulating and controlling the presentation of stimulus materials for instigating complex learning. Conduct investigations relating the structures, characteristics and orders of information to the processes of human perception and conceptualization. Finally, investigate the characteristics and potentials for individuals to develop their complex intellectual skills to very high levels.

Area 6. Learning Sets and Skills

Investigate the requirements and develop methods and procedures including all appropriate kinds of media, for increasing maximally the efficiency, rate, and span of comprehension, understanding and retention of learned information and skills. Attack the problems of training individuals in the instrumental skills of "learning how to learn", including "sets" and positive attitudes. Determine the conditions and requirements which are necessary for very significantly increasing the abilities of individuals to interact with learning materials and to abstract symbolic meanings from such material as print, pictures, demonstrations, experiments, observed situations, etc. Integrate newly acquired information and make appropriate responses and develop feasible procedures, using media where appropriate, to train large numbers of people rapidly in the basic skills of learning how to learn.

Area 7. Motivation for Learning

Investigate systematically the dynamics of motivation and "reinforcement" for learning. Conduct research on how different levels and kinds of motivation for learning are influenced, positively or negatively, by learning environments, including their physical and social components. Design, on the basis of validated evidence, "models" of motivational systems which have the potentiality of maximizing motivation for academic achievement and other adaptive behavior. Design methods and procedures for optimizing reward-and-penalty systems for both individuals and groups of learners; and, finally, test the practicability of the developed methods.

Area 8. Application of Research Results

Develop both theoretical and practical models of principles, methods and procedures for introducing proven practices and new instructional materials, as well as other adaptive developments, into schools, colleges, universities and other educational agencies. Communicate immediately the results of such research to those who need them, and especially to regional educational development organizations.

Area 9. Computer-Based Learning

Develop and prove computer-based and advanced systems of instrumentation for both research and practical applications. Such instrumentation should provide for: recording extensive data on learning as it occurs; regulating learning with speed and precision; storing ordered stimulus materials with patterned or random access; storing all necessary and relevant data on the pertinent characteristics of learners, using this stored information as well as the immediate performances of students, for pacing and routing students to the next steps of study required for the mastery of defined materials and tasks; immediately informing both students and teachers of the results being achieved by individuals and groups; finally, the rapid processing and summarization of all desired data.

Area 10. Systems Approach in Education

Develop and adapt systems analysis methods for uses in education, for analyzing "inputs" to the whole instructional system, for assessing the functions, means and methods of instruction and for assessing the results or "output" in terms of net learning gains. Develop and adapt the methods to different levels of education and demonstrate their feasibility and economy. Prepare directions and instructions for using the systems analysis approach and ensure its application, if justified, to regional educational development organizations.

Area 11. Genetic Determiners and their Effects

Investigate, in collaboration with other disciplines, the genetic determiners and the other physical bases of general intelligence and special abilities, and also the inheritance of these qualities in different human populations. Study systematically the effects of different cultures, sub-cultures, community, institutional and family configurations on the expression and the development of abilities. Finally, determine what, when and how limits are set on learning.

Area 12. Neuro-Physiological Correlates of Learning

Investigate brain functions, the physiological and neurological processes relating to learning using the theoretical approaches and hypotheses which postulate the brain as an information processing mechanism. Attempt to relate both theory and experimental results to the learning and retention of complex intellectual skills to ascertain how these are instigated and organized. Explore the possibilities that these or other systematic theoretical formulations and related research may extend knowledge about complex, meaningful and useful human learning.

These examples indicate the kinds of areas which require strong, sustained and high quality research if they are to be attacked successfully and adequately. Such areas contain problems, hypotheses and questions for which research methodologies are appropriate. Furthermore, the solutions, resolutions and answers are seriously needed by education and, when available, would be of inestimable value to the nation. These are the kinds of research areas, therefore, which the majority of participants in this study would agree provide sufficient and sound justification for the plan for research centers on human learning.

F. Authoritative Supporting Statements For the Concept of Learning Research Centers

In this section summary comments from the ten resource papers and the Southern Regional Education Board conference are presented to point up the need and justifications for research centers. The complete resource papers are reproduced in Appendix 1, p. 112.

John T. Wilson

University of Chicago

Justification: Substantive Comments

"If we are to concern ourselves with this general problem [the development of intellectual talents] * (and if we are to survive as a nation in the competition facing us, we must) several approaches are possible. Indeed, some aspects of the problem are under intensive investigation already by a number of competent people. Various studies are being made regarding the need for more school facilities; for new and enriched curricula, particularly in science areas; for enhanced teachers salaries; and so forth. In all of this activity one aspect of the problem, the learning process itself, is not being intensively studied. This is especially true when one considers the learning process at the human level, wherein learning is of primary concern to parents, to those concerned with the educational system, to those who are hiring skilled technical workers, to those interested in the problems of continued learning among our senior citizens.

"It is an interesting and paradoxical feature of the pragmatic culture of the United States, that those individuals whose scientific interests are centered around the technical area of 'learning' have in large measure assiduously avoided tackling human learning problems in settings that are relevant either to everyday learning in a social setting, or to learning as a process confronting the student, at any level. Historically, American educators interested in the psychology of learning, and American psychologists interested in the problems of education, oriented their research toward increasing the 'efficiency' of formal education. With an increased concern in educational circles with the pervasiveness of factors influencing learning, research on human learning came to be viewed as being of such complexity, that it was unmanageable with any degree of precision. Hence, one alternative open to the scientific study of learning was retreat

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* Editor's brackets

to lower phylogenetic levels. This procedure allowed better control of learning behavior, in laboratory animals such as rats, cats, pigeons, monkeys and chimpanzees - - even though the data derived from such research had little, if any, bearing upon the human learning process. Another alternative, that of reducing the human learning process to a minimally complex and manageable level, was chosen by some psychologists, among whom are those using 'nonsense syllables' and 'memory drums' or various simplified psycho-motor tasks to study learning. Here again, the data bear little upon problems of complex human learning, although the data from psychomotor laboratories have contributed to selection and classification procedures within the military and within industry.

"The present state of research in human learning, although widely supported, is, compared to the state of scientific development in modern physics and modern biology, primitive and unsystematic. In fact, learning as a variable pervades almost all areas of experimentation in the general field of psychology, and is to be found discussed under such headings as: 'the developing child', 'individual differences', 'personality development', 'concept formation', 'thinking', 'problem solving', etc. In the more formal educational setting, studies of human learning are integral parts of routine practical service studies, curricular studies, methods studies, etc. The confused state of research in the general area is perhaps the aftermath of earlier held hopes that problems of human learning, particularly in the formal setting of school learning, would yield to simple studies and theories. This hope having been shattered, the research effort seems to have proliferated in innumerable directions, almost vitiating the possibility of integrative programs of research.

"In a substantive sense, there is no better justification for the creation of research centers, than the obvious need to apply a brake to the proliferation in research problems of an individual, miniscule nature, which individually contribute little to a coherent, systematic approach to research on the human learning process. This is not to say that the individual scientist should not be allowed, indeed, encouraged, to pursue his problem in any way he best sees fit. It is to say that research programs can be oriented around central issues within the general area of human learning, that individuals who are interested in a given issue can be brought into closer communication with each other, and that in so doing, more effective effort may be brought to bear upon the major problem areas in a way which will enhance the probability of their solution. The pattern is essentially that of the 'research institute', a concept which is lacking in most areas of behavioral science and certainly in the area of human learning.

Justification: A National Responsibility

"Although not specifically mentioned as such, it is precisely such an area as research in human learning that the President's Science Advisory Committee had implicitly in mind when, in the 'Seaborg Report',* the Committee described the government's responsibility for 'developing' new or neglected areas of science. After pointing out that grants and contracts to individual scientists are most useful in supporting specific research projects, especially when such support is provided with a minimum of red-tape and with relatively long time schedules, the report goes on to point out that project support, in and of itself, does not fully meet the needs:

> 'We can understand this matter better if we consider for a moment the Federal Government's larger purposes in relation to basic research and graduate education. In addition to the research interests of particular agencies, the government has two other more general responsibilities. One is its concern for the development of fields of basic and applied science which may be of general importance for the national security and the general welfare; the other is its concern for the strength of American science and higher education as a whole.
>
> 'There are many fields of science in which the United States could well become stronger and more active, both from the point of view of the national defense and from that of the public welfare. It is unfortunately not true that scientists always and automatically sort themselves out into the most relevant and productive fields of work. Science like any other human activity is subject to the distortion of human frailty, and scientific fashion is not always sound. Moreover, even when individual scientists spot promising untilled fields (and it is the scientists who do spot them) it is often hard to find funds and facilities for the new undertaking from within hard-pressed universities.

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*Scientific Progress, The Universities, and The Federal Government, Statement by the President's Science Advisory Committee, The White House, Washington, D.C. November 15, 1960, p. 8-9

> 'We think it plain that the Federal Government should act in such areas of scientific promise. No other agency in our society is responsible for the national security, and a large field, full of new problems, such as space science or materials research, is potentially vital to our safety. No other agency in our society is responsible for the general welfare, and all major fields without exception can be expected to contribute to the general welfare. No other agency, finally has the financial strength to provide the necessary support - - and incentive - - for work in expensive new undertakings. It can be said without qualification that our society will be endangered and impoverished if these things are not done, and that only the Federal Government can take the leadership to get them done. We do not mean, again, that only Federal action will be needed; we do mean that it must play a large initiating and sustaining role.'

"Thus, in a substantive sense, the establishment of research centers would enhance sustained systematic work on the central issues confronting us in understanding the learning process. This is in contrast to scattered, individualistic attacks on smaller parts of the major issues. Specific examples of several 'problem areas' and examples of 'research centers' which have made significant contributions to related areas of science as a result of concerted efforts are outlined below. In the broader sense of national responsibility, we see that the general field of human learning is one which aptly fits the need for development of neglected areas of science as described by the President's Science Advisory Committee."

Richard S. Crutchfield

University of California,
Berkeley

Justifications for Regional Centers

"We are in a period of great ferment in research on human learning and its application in the educational process. Fundamental advances are being made all along the learning frontier, ranging from break-throughs in work on the biochemistry and neurology of the learning process, to new conceptions of complex verbal learning, to esoteric work in the computer simulation of cognition. A fresh spirit of innovation is sweeping the educational field, bringing basic redesigning of school curricula, active experimentation in the classroom, and widespread exploration of new educational media, for example the use of television and other audio-visual techniques, and the use of teaching machines, programmed textbooks, and related self-instructional devices.

"To a greater degree than ever before, experts in a wide variety of disciplines and technologies are combining their research efforts in an attack on the problems of the learning and teaching processes. The time is extraordinarily auspicious for a much larger and more concerted attack on these problems. There is unprecedented opportunity in the next several decades to make research advances in this field that may have the widest possible implications for the role of education in our society. Radical advances in nuclear science and space engineering, and other industrial technological developments, have outstripped advances in the understanding of the educational process to a degree that strikes many as dangerous. Moreover, the world-wide population explosion, together with the revolutionary social ferment in the developing countries of the world, make the needs of mass educational resources vastly greater and more urgent than ever before. For it is only through the utilization of education that man can hope to control and constructively use these unprecedented physical and social forces which are being released.

"Our society, and the world at large, can thus afford nothing less than a maximal effort in basic research and the application of its results to the field of human learning. Present efforts, promising as they are, fall far short of what is needed. The sheer amount of research support currently available is a tiny fraction of that required to exploit to the full the promising break-throughs which have already been achieved. In many of the current research enterprises in the field there is inadequate provision for the development of comprehensive programs of research on fundamental problems. Long-term learning research programs are difficult to carry out now, because of short-term financing and short-lived participation of the initiating researcher. Current investigators often have little cognizance of the ongoing work in other laboratories and in other disciplines, and there are often needless duplications of some aspects of research as well as large gaps in other aspects. There is a serious disjunction between research in the laboratory and application in the school setting.

"The establishment of a number of regional learning research centers having clear programmatic orientation and generous budgetary support could contribute significantly to the remedy of these deficiencies. The prime purpose of such centers would be to accomplish ends that cannot be accomplished by existing projects and facilities.

"1. The centers would provide major physical facilities essential for the conducting of large-scale, highly complex, and long-range research for which adequate facilities are nowhere now in existence.

"2. Being planned around comprehensive programs of research, such centers would make possible a systematic attack on fundamental research questions having a scope and a continuity and requiring a mobilization of research resources far beyond the capability of single investigators or projects. Such programs of research can provide an over-all picture of progress in a field, showing where gaps exist and where promising leads lie. And they can provide a systematic framework facilitating the seeing of conceptual relationships between the findings from separate studies that otherwise may appear unconnected.

"3. Such centers would provide the stimulus and means for inter-disciplinary work, drawing together the contributions of specialists in a wide variety of fields. Included would be not only experts in psychological research, but also scholars in various subject-matter areas, and specialists in the advanced technology of educational media. An auspicious climate would thus be established for the development of what is essentially a new discipline, centered on educational learning research, welded together out of what are now diverse fields. In this connection the centers would fulfill an indispensable research training function, both for students and for mature investigators.

"4. Such centers could provide a much-needed bridge between laboratory-centered research on the learning process and school-centered research on the educational applications. They would also help to bring about a much closer working relationship between those individuals concerned with the teaching and learning of specific subject matters and the development of improved curriculum content, and those individuals concerned with the more general processes of learning and teaching.

"5. Such centers, being regional in character, would provide a means for inter-institutional research on learning problems of large scope. They would also make accessible much-needed research resources to individual investigators in the numerous and scattered smaller institutions within a region where it would not be feasible to duplicate extremely costly facilities.

"6. Less tangible, but no less significant, is the contribution such centers could make in instilling a sense of urgency about research on human learning that would help arouse the interest of many more of the most highly qualified and creative research experts drawn from neighboring disciplines, as well as from psychology and education, and thus enlist their participation in the research.

"It is to be emphasized that the centers are not intended to replace or to inhibit the individual research projects that are now being carried on and must continue to be carried on. Such projects serve indispensable functions, and indeed would profit from greatly expanded support over present levels. They provide the essential safeguard for unique lines of inquiry, for contradictory points of view, for individual innovation. And these are values which no large and highly programmatic research center can hope to maintain in the optimal degree. The proposed learning research centers, therefore, are to be thought of as an essential complement to the already existing research activity by individuals and groups throughout the country."

W. C. Meierhenry

University of Nebraska

A Rationale

"The discussion which is presented in the resource paper has been developed from a premise that regional research centers are more desirable and necessary than having one large national center or hundreds of independent research projects scattered around the country with individual scholars and institutions. This position is taken for several reasons:

"1. Politically, it is more expedient to develop regional centers rather than a national center. This grows out of the great concern, both within and without the Congress, to be certain that controls are not exercised over education at the national level.

"2. It is possible to attack problems of major national concern better through regional centers than would be the case if it were all locally conceived and conducted.

"3. It will be possible to rather clearly delineate the responsibilities of the various regional research centers so that they will operate within a structure and framework without stifling individual researchers.

"4. Participation in research projects and the acceptance of the results of the experiments will be more readily accepted by the educational institutions if the research is done at a regional level rather than either the local or the national level.

. . . .

"The point of view of this document is that, because of the peculiar nature of education in the United States, it is desirable to operate through regions for broad scale attacks on problems with the necessary coordination at the national level possible through various kinds of administrative and committee devices."

Roger W. Russell

and

Douglas G. Ellson

Indiana University

Summary Statements

"Perhaps never before in history have there been more striking examples of the importance of education to human welfare and to national and international affairs than those which are clearly apparent today. Research and development by highly trained experts are leading to breakthroughs in the treatment of diseases, to the raising of standards of living, to increasing control of the physical environment, and even to steps into space. Education is playing a basic role in the success of newly independent nations in which democratic institutions of government depend upon an educated citizenry capable of accepting group responsibilities and of expressing its views wisely. Intellectual achievements have become features of foreign policy. Under such circumstances the nation must make full use of its human resources. This requires that all citizens be as skillful and knowledgeable as possible and that all be given opportunities to develop their educational potentials to the fullest extent of their capabilities. With these objectives in mind, nothing could be more remiss than to ignore the possibilities of improving our educational processes. Attempts toward improvement may be made by debate or by systematic study of the factors and conditions which affect educability. The research approach has characterized the nation's success in attacking other kinds of problems; it would indeed be strange if it were not the preferred approach in attempts to solve problems in education.

"Among the problems in education in need of immediate attention are a number which center around the learner and the learning process. General problems of this kind have been subjected to a very considerable amount of research during recent years, but the research has been primarily oriented toward the controlled conditions of the laboratory and not toward students in educational environments. The need now is research aimed at application of the techniques, the knowledge of important variables, the basic concepts and principles to the practical problems of the realistic educational situation.

"Applications of research know-how to the solution of educational problems are increasing, to a great extent due to recent increases in financial support of individual research projects. Experience with such individual projects suggests that it may now be time to consider seriously the advantages to our overall research effort of establishing research centers to supplement individuals' endeavors. A number of advantages are listed at the beginning of this paper.

"The advantages are sufficiently impressive to warrant at least an empirical test of the research center concept in the context of educational research. The cost of such a test would not be great; the payoff in terms of advances in the efficacy of our educational processes might be."

Dale B. Harris

The Pennsylvania State University

Educational Experimentation and the Experimental Model

"Public schools have for years kept records, but these records have been primarily for descriptive purposes rather than for basic research. It is shocking that so few long time studies of school achievement have been made, when standard tests have been in use for almost half a century. Developmental psychologists have not communicated their concepts and strategies to educational researchers.

"It is now time to make an experimental approach to education on a large enough scale to assure adequate testing and records, and over a long enough time to measure the cumulative impact of influences. Instruments for appraising achievement and performance are sufficiently good that positive outcomes are more certain in this area than in the area of personality and attitudes. Moreover, we have learned to design research on a scale sufficient to provide adequate controls over a period of years. Such a plan, however, must be carried forward in the community context where there are children.

"The need for an experimental program constructed around the developmental model is obvious."

Paul Dressel

Michigan State University

Summary Statements

"Despite all of the technological advances which society had made, teaching is still conducted pretty much in the traditional fashion which was evident centuries ago. Our attempts to educate teachers with regard to principles of learning have not been successful because we have not had an adequate understanding of the nature of human learning. At this point in time we are on the fringe (by virtue of the development of teaching machines, audio-visual aids, television, and other related technological items, such as computers) of a complete redefinition of the nature of the teaching-learning process. It is vitally important that these newer media be properly fitted into the educational program in relationship to the knowledge of some fundamental principles. It is essential also that we do not simply displace the teacher, who will remain a central feature of the educational program, but whose role must somehow be redefined as a planner and coordinator of learning activity rather than as a presenter of factual material. It is essential to the future of our civilization that the increasingly large numbers of individuals seeking higher education be accomodated. And it is equally essential that we find new, better, and more economical ways of carrying on education. The amount and the difficulty of knowledge which young people must amass is continually increasing. The necessity of freeing our scholars for more research activity to further expand this knowledge is pressing. Our time-honored procedures are not only too expensive in manpower but they also provide too little opportunity for the individual student to develop at his own pace and to become acquainted with the really significant thinkers and problems of the present day. Increasingly, the focus must be learning and, to make it so, we must know far more about learning than we now do."

Leonard Mead

and

Ezra Saul

Tufts University

Summary Statements

"Particularly as a result of its short term character, much of the previously accomplished and currently pursued research in complex human learning leaves the behavioral scientist and educator with serious unanswered questions concerning the determinants of complex human learning. In addition, the general lack of long-term support and the nonprogrammatic character of current research prevents the recruitment and maintenance of highly competent staff which are so necessary to attack in a significant manner the many fundamental questions that need to be studied.

"Were long-term programmatic learning research centers to be established, it is considered critical that they concern themselves with the following kinds of issues:

"(1) The specification, in behavioral terms, of educational and training goals necessary to achieve the broad purposes of the society and the nation.

"(2) The preparation of the most appropriate program content, instructional methods, and tools for learning for the accomplishment of such behavioral goals.

"(3) The pursuit of understanding and successful manipulation of the determinants of curiosity and other motives compatible with and necessary for learning.

"(4) The pursuit of research regarding the neurophysiological and genetic determinants of complex human learning, with particular reference to the known classes of organic pathology limiting learning.

"(5) The continuation of imaginatively conceived and rigorously pursued formulation of basic theory related to human learning phenomena and educational practice.

"All things considered, no process other than learning is more appropriately manipulated in the preparation of the members of a democratic society to adopt their adult roles. Furthermore, no process other than highly successful learning, better prepares a democratic society to meet challenges and to pursue social change. It follows that efforts necessary to extend our understanding and control of complex human learning are essential if we are optimally to prepare the members of our society for future as well as current social challenges."

Richard C. Atkinson

and

Patrick Suppes

Stanford University

Summary Statement

"We propose that a research laboratory be established for the quantitative study of higher learning processes. In recent years advances in learning theory have indicated the feasibility of developing mathematical models of the teaching process. In terms of such models one can derive in an exact fashion schedules and methods for presenting instructional materials that optimize the efficiency of the learning process. The major focus of the laboratory would be to investigate the increased efficiency in learning that can be obtained by specifying optimal instructional programs for individual students. At the present time, there are a number of general ideas we consider both significant and practical to investigate within this general framework. They are as follows: the learning of elementary mathematical concepts by school-aged children; research on problems involved in teaching students how to do mathematical proofs; research on the acquisition of reading skills in young children; and the acquisition of a second language. In order to conduct research on optimal programming methods, it would be necessary to construct a computer-based classroom facility that would give the experimenter high-speed flexibility in scheduling auditory and visual information and in recording responses and latencies for individual subjects."

Lester Beck

Portland State College

Summary Statements

"Learning is the most important activity of man yet there has been no long-range coordinated research program of study on how and why it occurs. Research by individuals and groups has revealed some of the conditions under which learning occurs, but there is fragmentation and lack of overall continuity in what has been reported. If the resources of our people are to be developed fully, a systematic program of studies of learning at all ages is needed. These should cover subject matter, methods, environment, behavioral correlates, including attitudes and values, and biological correlates.

"With a small portion of our people making great strides in power and space research, it seems necessary to plan for the highest educational development possible of all citizens in a democracy, both to support production of new vehicles and to use them wisely. The wisdom and understanding of people in a democratic society are necessary to the constructive use of the new power which physical scientists are making available. Basic research in learning can show the way to make the most of important national resources."

John Barson

and

Robert W. Kilbourn

Wayne State University

Summary Statements

"It should not be difficult to justify a greatly expanded program of research effort dealing with applications of technology in the educational process. Our present systems of education have expedited the technological revolutions of recent years, yet these very systems are among the last institutions in our society to benefit from technological advance. Industry and the military have advanced through use of information and storage and retrieval mechanisms in their operations; but, use of these mechanisms in schools is practically non-existent. Yet, information handling is one of the major businesses of the educational process.

"We have only recently achieved the kind of information storage and retrieval mechanisms necessary to handle the problems of education of individuals. Yet, we continue on a mass-indoctrination base as a framework for operating our educational system. This mass base of operations may no longer be required if we make intelligent use of modern information storage and retrieval mechanisms that will allow individuals to learn at their own pace and to select those experiences which are most important to them for learning.

"No aspect of the national welfare is more crucial than the problems of education in urban areas. A tremendous majority of our population will live in urban areas in the forseeable future. Many of these people will be displaced from the jobs for which they are trained by new technological developments. The physical facilities of the center city are deteriorating at a more rapid rate than they can be replaced by even today's great redevelopment effort. Redevelopment of the city contains problems not only of physical rebuilding but also problems of human re-education. Human beings must be re-educated to perform the new jobs in a new society.

We cannot consign the inhabitants of the center city to the scrapheap. This we will continue to do unless we retrain these people for useful social functions when they have been displaced by technological development from their former positions.

"To know, as we now seem fairly certain, that any of the media of communication can be used for learning is small comfort. We must, at the same time, know exactly what strategy or tactics we should use in preparing program materials for the media. Nearly all tactics of use of media up to the present time have concentrated upon the use of media in ways much like the behavior of the teacher in the classroom. Obviously, this is an inadequate concept of media usage."

Conference on Regional Learning Research Centers

SREB Offices

Atlanta, Georgia
Mary Howard Smith

The Need for Regional Learning Research Centers

"The mushrooming size of the country's educational task, the urgency of educating more people better and faster, and the promise of new media as a means of accomplishing these things were all accepted by this conference as basic assumptions pointing to a need for a massive, systematic, and sustained effort to discover more about the processes of teaching and learning.

"The effort envisioned here should be of a magnitude that does not now exist and should have a continuity that is not now possible. It must be of a size and degree of permanence sufficient to enable us to pursue experimentation with multiple variants so that findings begin to combine into meaningful patterns. It must provide a vehicle for drawing together many data from many sources and evaluating them. It should offer a mechanism for assembling the findings of sound experimentation, and for demonstrations in putting them together in patterns of use. As research is applied from the primate to the laboratory class to the regular classroom to the school system, changes take place along the way, and we need a mechanism to bridge the gaps in its progress. We need also a mechanism to reduce the lag in feedback from research to application and back again to research. Finally, we need the means of bringing to bear on the problems of teaching and learning the thinking and orientations of many disciplines.

"Since time is of the essence, it is no longer advisable to continue, even on a stepped-up basis, with a project approach to this broadly conceived problem. This conclusion in no way deprecates the very real contributions already made under Title VII of the National Defense Education Act.

"Research made possible under NDEA grants has taken us to a certain point, but to go to the next plateau we need a bigger program with continuity built in and with application and field interpretation added. Recent and current projects are scattered, do not have opportunity for continuity, and do not add up to a program which makes a real dent on the central problems of establishing a science of learning. Since the NDEA can react only to proposals received, there is little possibility of mounting a concerted effort by this means.

"Programmatic research of the scope and complexity called for here could probably best be designed and administered in one or more centers specifically for this purpose. Such an approach would make possible a permanent core staff, a greater scope of interest, and well-developed facilities, and would lessen the likelihood of the whole program being irrevocably attached to one key investigator. The programmatic approach to research through specified centers has proven viable in other fields (such as ordnance) and there seems to be no reason why the concept could not be extended to educational research."

IV. GENERIC CHARACTERISTICS OF THE PLAN FOR REGIONAL LEARNING RESEARCH CENTERS

Early in the previous chapter, the question was raised of whether needs and justifications exist for expanding research and development efforts in the area of human learning and its mediating conditions. The evidence, viewpoints and judgments which have been summarized in this study give a positive and almost unanimous answer to this question. Extensive needs exist; learning is a neglected but centrally important area for research; a greatly increased effort can be justified.

The second basic question was, should the expanded effort be in the form of the establishment and operation of regional learning research centers? The viewpoints, opinions, judgments and evidence have been reviewed and the answer again is strongly positive, provided that certain requirements are met. The centers must have specified characteristics to ensure the conditions necessary for creative and productive research on a scale commensurate with the needs for new knowledge on learning processes which will contribute significantly to the development of solutions to important educational problems. Furthermore, it is planned that schools and instructional programs of institutions of higher education will be involved closely in the research and development work of the centers and actively implement proven results.

The purpose of this section is to describe the required numbers, general characteristics and conditions of centers, criteria for location and assessment, costs and possible sources of financing.

A. Number and Schedule of Establishment

The evidence collected and judgments expressed during this study varied greatly on the number of centers that would be desirable and the most suitable schedule for establishing them. Considering the great need, the readiness of professional people and their institutions to act, the extended national area, with its large population and extensive and varied educational problems to be covered, the number of qualified locations for learning centers and existing regional complexes of educational agencies, and especially, with respect to the nine regions being defined for the Regional Educational

Development Organizations (The Oregon Plan), the most frequent conclusions can be summarized as follows:

1. A national complement of the centers, more than two or three but fewer than the number of states in the nation, should be established.

2. The number should be so related to the amount of funds and other resources as to provide desirable concentration and focus in research and development efforts as well as increasing professional and public "visibility".

3. Conditional on the plan for the Regional Educational Development Organizations, its implementation, and the number of regions defined by this plan, the planning group believes that there should eventually be at least one research center in each of the specified educational development regions. If there are to be 9 regions, then there should be developed at least 9 regional research centers.

4. Many of the conferences and resource papers suggested the need for some special-purpose centers, for example, on instructional media, developmental studies of children, motivation, neural and biochemical bases of learning, reading and writing, maturation of conceptual patterning, creativity, etc.

   In addition, it was suggested that a few of the centers might require and would be uniquely distinguished by special buildings and equipment. For example, one such center might be completely equipped for large-scale, complex media research, or be built and equipped as a modern computer-based experimental school, or be equipped and staffed for a major effort on research and development of learning skills and attitudes.

   Accordingly, the planning group proposes for the generic plan three national special-function centers.

5. A total of twelve centers should be projected for the nation.

The schedule of establishing the centers, based on needs and their probable contributions, should ideally be that all twelve be fully established during 1962 and 1963. Indeed, extensive discussions were held on the possibility of recommending that all twelve centers be begun in 1962 by launching continuing programs of research at places where the regional centers would subsequently be located and developed. However, it was generally agreed that this would disperse the immediately available resources too widely throughout the nation. This dispersion would be contrary to the belief that the initial efforts should be concentrated and given wide public and professional visibility. The evidence collected suggests that a reasonable compromise would be to establish four centers in 1962; one each in the east, midwest, south and west coast. Of these four, one should be projected as a special-function center. All four could be initiated in their first development phase by grants or contracts for sustained programs of research.

The planning group, after a thorough study of substantial information, but excluding the factor of availability of funds, proposed that the general schedule for establishing the twelve centers should be as follows: four in 1962, three in 1964, three in 1965 and two in 1966. In relation to the forseeable demands that will be made on education in this country, it would be desirable, if possible, to accelerate the establishment schedule.

The planning group also suggested that the schedule for establishing nine of the research centers should be coordinated, region by region, with the formation of the nine Regional Educational Development Organizations.

B. Purpose of Centers

The purposes and objectives of the centers should be:

1. To conduct high quality research and development programs in broadly defined areas of meaningful human learning and on its mediating conditions and instructional materials.

2. To assess what is known about learning and its regulation, extend basic knowledge, apply this knowledge, and design and test useful models and systems of educational developments.

3. To involve selected schools, colleges and universities of a defined region in the research effort and to communicate these results to Regional Educational Development Organizations and other practical educational groups for further testing and for implementation.

C. A General Task Order

In order to accomplish the purposes stated above the sponsoring agency should prepare a general task order for each center. Such a task order might contain the following concepts:

1. The center shall conduct research on a continuing basis in the broad areas of the science of human learning involving related disciplines of the life sciences and social sciences and such other disciplines as may be necessary in order to advance significantly basic knowledge about human learning and, through applied research and development, to contribute importantly to the solution of the nation's critical educational problems.

2. The university or association of universities responsible for a center shall establish an organization for learning and for educational-media research, employ the most competent personnel available, and conduct cooperative training programs at the doctoral and post-doctoral levels. They shall develop modern research plants and equip them with facilities and instrumentation of advanced design and provide for the focus and use of the resources of the defined region in the area of research and development on learning by arranging cooperative programs with interested educational institutions, schools, non-profit organizations, universities and community educational agencies. They shall provide resources including funds, personnel, space and facilities to assist cooperating institutions and agencies to carry out their parts of programs, and to take such other actions as may be required to accomplish the intent and purposes of this plan.

3. The responsible university or association of universities shall be legally empowered to contract for the conduct of research and development, to solicit and accept grants and contributions from Federal and State educational agencies, foundations, non-profit organizations, and industries, provided such contracts and grants do not restrict or limit the accomplishment of the stated objectives of the center.

D. Characteristics

The statement of the purposes of the centers and the suggested statements for a founding task order indicate that the centers as visualized have certain general characteristics. These will now be defined in more detail:

1. Variations in Size and Functions

Variations in the organizational patterns of the centers and their research functions were suggested by many conference participants. Therefore it is proposed that the generic plan might include designs for variations both in sizes and functions.

The centers may vary in the size of their core staff, as suggested in conference notes and resource papers, from 5 to 25 investigators with each principal research man being supported by about four individuals, graduate students, secretaries, technicians, assistants and specialists. A few centers may have specially constructed buildings and facilities. Estimates for the costs of building and facilities where needed have ranged from $ 1½ million for the minimum research centers to $ 8-10 million for the most highly developed special-function, computer-based or media-emphasized research programs.

For interdisciplinary research existing departments may be involved such as education, psychology, sociology, mathematics and statistics, physiology, philosophy and logic, language and linguistics, speech and communications, economics, institutional studies and engineering, etc. In addition, a full range of other content fields, curricula, and courses, at all levels of public schools and colleges may be involved in the research. It became clear repeatedly in discussion that the center should not, in general, be media-oriented but should focus on learning with the media playing appropriate roles.

Patterns of institutional cooperation in and among regions should be expected to vary both during the development phases and after the centers are fully developed. At one extreme, one university may serve as the base and work cooperatively with several selected colleges and school systems. At the other extreme, eight or ten universities may be associated and work coordinatedly with the colleges and schools of the whole region. Between these extremes there could be many other variations among the centers.

The general recommendation is that the size and patterns of a regional research center be determined following detailed studies of a specific region's mobilizable resources. The pattern of research and development should grow out of the successful research experiences of competent investigators, their present research activities, and their interest in areas of research that are in the national interest. It is not recommended that a general plan be developed and laid down in a region without many adaptations and variations.

2. The Regionality Concept

Whereas the conferences and resource papers reflect a ready acceptance of interdisciplinary cooperation in proposed research on human learning, and show a mature realization of its importance in relation to the complexity of the subject, the regional or inter-institutional cooperative concept was a topic of many long and intense debates. These discussions seem to reflect considerable reservations about the need, desirability and feasibility of the regional approach to the conduct of basic and applied research. However, it seemed to be agreed that the regional approach was necessary for many kinds of educational developments particularly those involving school systems. (See the section reporting the results of the exploratory conference on possibilities of cooperation in the Mid-Atlantic Region pp.100 - 103.)

It was generally believed that the regional concept was desirable in order to gain public, legislative and professional support for the centers. Properly organized and administered, centers could make decisions on administrative matters, resources,and research programs closely related to the interests and needs of the region. Such centers might stimulate research interests and provide research opportunities for individuals and institutions, especially schools and colleges, which otherwise might not ever take part actively in quality research on human learning. The coordination of efforts could prevent the isolation of individuals, reduce wasteful duplication, ensure the orderly development of continuing research programs and help to focus efforts on really important problems and critical educational issues. Expensive, and in some instances, rather elaborate physical facilities that cannot be provided for many locations could be made available regionally or even nationally on a cooperative basis. Indeed, such facilities, instrumentation, space, good working conditions, adequate resources, including technical support, and availability of subjects may be the critical requirements for ensuring the success of regional cooperation in research. To be successful the arrangement must provide for investigators clear and distinct advantages; advantages of the kind just discussed, which many people interested in learning research report they do not now have.

The thought was expressed frequently that although the centers may be regional in operation, the results of research would be made available throughout the nation and the world. This thought suggested the next, namely, that plans for one region's programs of research should be made known rapidly and continuously to the centers and development organizations in all other regions. For this purpose it was suggested that the research directors might be constituted as a research plans coordinating group and that a rapid communication system could be activated, perhaps using nationwide television for reporting and demonstrating results to the educational development organizations, professional groups and the public.

Generally, it was agreed that the basic research problems in the area of meaningful human learning do not vary greatly from one region to another in this country. However, the conditions of learning may vary greatly both within and among regions. It was believed that there would be the most variations on the level of educational development, a situation which would support the regional approach. This fact, in turn, argues for the regional location of research centers since they are to be supportive and responsive to educational operations.

3. University-Based Centers

There were only minor dissents to the proposal that the learning research centers be based at and administered by universities. Universities are already active research centers. They have most of the scholars and investigators who are competent to conduct research on the basic and intermediate levels. The conduct ongoing research on learning, and have the capabilities, given the funds, for greatly expanding their efforts. Universities are responsible for graduate training, and any research of the breadth and depth proposed will require large numbers of advanced graduate students and will contribute significantly to their professional training. The centers must recruit and train future staff members from populations of graduate students and young post-doctoral people.

Universities train many teachers and almost all school principals, superintendents and administrators. State universities, especially, are typically believed to be the capstones of the educational systems of their respective states and a major source of leadership in matters of curriculum and educational practices.

In the areas of applied learning research and educational developments universities will need to change their attitudes and expand their efforts toward cooperation with public schools and other colleges.

Most universities encourage and sponsor a variety of research on many subjects but little research on their own instructional programs or on complex academic learning - - areas of major concern to universities and colleges. The presence on or near their campuses of large and active learning research centers would be a powerful force to stimulate these needed changes and expansions.

The university-based learning centers should be expected to launch extensive programs of research dealing with the learning of academic subjects taught on the levels of higher education as well as on subjects taught in schools. This research should be staged in the context of academic life and work. Such research will be required to deal with the problems of learning and media as previously outlined in the listing of research areas. This kind of contextual research is most difficult to conduct. That it can be done in colleges and universities, however, has been successfully demonstrated in many institutions during recent years. When accomplished, contextual research has one great advantage among others; the results are applicable to instruction and academic learning because these have been the conditions of the experimentation.

The alternatives to university-based learning centers are not very promising. It is the very exceptional school system or state educational agency which can conduct successfully the kinds of research visualized for the centers. These agencies are the appropriate and essential agencies for the application and implementation of research results. Non-profit or not-for-profit organizations may be expected to be associated with centers in their regions. They generally do not meet all of the criteria for a center (see list of criteria for selecting locations pp.88-91). No known industry could or would launch a learning research center at this time, except on its own training programs. If either large industries or foundations were to decide to establish and support human learning research centers like those called for by this plan, they would most probably do so in and through selected universities.

In brief, therefore, the proposed human learning research centers should be based in or with universities, and provide the bases for research efforts of the schools and colleges of the region.

4. Sustained and Adequate Support

The one feature of the hypothetical models as developed in the original proposal and as further elaborated and tested in the initial planning conference and throughout this study, that most appealed to specialists and research men was the characteristic of sustained or continuing support. This requirement was specified by many individuals in the conferences and in all of the resource papers.

It appears that many competent and mature investigators, after long periods when their research efforts have depended on short-term grants and contracts, often from a variety of government agencies and foundations, become tired and disenchanted with this pattern of research support. As a consequence, many first-rate research men discontinue making applications for small short-term grants and contracts. Furthermore, these men begin to seek support from sources which do provide longer term sustained support and even move to universities where the probabilities of sustained support are increased.

It is important to repeat the observations that when a research area of major importance is defined in fields of science, health and engineering, it is not unusual to establish plans for sustained efforts, institutes, laboratories and centers (see examples of these on pp.38-40).The area of human learning is one of major importance and deserves similar attention and support.

It is recognized that Federal agencies must thoroughly justify support of continuing large-scale programmatic research in addition to the more popular and more traditional project type of research funds allocations. However, the precedents do exist; examples are numerous; the achievements often reach new levels of scientific and technical advances.

The centers should be established with the intent and commitment of continuing them on whatever level of financing is decided upon for their initial development and on to full-scale operations. The proposed plan of financing for each center should be projected over at least a five year period. It could then be extended each year for an additional five year period. A more desirable course would be to use a ten year life period with extensions of grants each year after the first. The authorization beyond fiscal appropriation periods will of course have to be contingent upon congressional appropriations. This type of plan has been put into effect by other agencies in areas such as radio-astronomy, materials research, primate research and others. The same kind of scheduled financing should be used for the centers.

This plan proposes sustained programmatic research because the areas of learning research and development require this approach if favorable conditions are to be arranged for solving the many and complex problems of meaningful human learning.

5. Organization

The consensus of those who have contributed to the several conferences and to the resource papers indicates that no one pattern of organization should be followed in the establishment of centers. Instead, as has been suggested, they should have varied patterns. A general outline of organization is proposed which requires adaptations to regional conditions and to the cooperating institutions.

General Requirements

a. The center should be "integrated" with the learning community of which it must be an accepted part. Clearly, only by obtaining knowledge of existing local conditions in a region and at institutions within that region, can integrating arrangements be specified.

b. Centers should have as their main objective the advancement of knowledge about human learning involving interdisciplinary research; hence, they should not be organized as agencies for conducting educational operations, although they should serve advanced training functions at the doctoral and post-doctoral levels.

c. Each center should have reasonable autonomy for accomplishing its main purposes. This will require the development of new patterns of administrative and cooperative relationships with institutions of the region and with their formal sub-divisions. Each center should operate from a neutral zone that is open and accessible for cooperation with schools, colleges, universities and their departments wherever mutual advantages can be served and without unnecessary restrictions by formal channels of organization.

d. Inter-institutional cooperation is possible and highly desirable. As one writer of a resource paper expressed it, "The genius of the regional movement is cooperation rather than competition among institutions and scholars." (Meierhenry) Again, the specific pattern which might be established should be permitted to vary with regional conditions.

Usually, it would desirable for a center to conduct symposia and seminars on its research work, needs and results. The people of a region who are actively concerned with the problems under investigation should participate, including educators in schools and colleges, and people from industrial training programs, State educational agencies and educational development organizations.

In addition, some colleges and public schools within a region should participate in planning research programs or become research stations at which particular projects of the programmatic research would be conducted. The research at these stations might be supported by funds obtained through direct grants from Federal, State or private agencies or by funds drawn from the budget of the center. In the latter case, funds from the center should be supplied on the basis of the merits and needs of the project on a non-competitive basis, for almost all conference participants opposed having a center serve fund-granting functions.

Thus, through the regional advisory board, (described on pages 78 - 79) through symposia, through the center and station relations, through the several media within a region, and through cooperation with Educational Development Organization, information should flow rapidly and effectively into and out of a center. If the work of the center is of the quality which is desired and needed, and if its level of financial support is adequate and sustained, other lines of cooperation and coordination will evolve within a region. For example, it is conceivable that the chief state school officers within a region might establish committees of curricula and research specialists charged with translating the research results into action for the schools of the region. In a strong viable center, the training of research personnel from schools and colleges of the region will contribute significantly to the integration of the center with the learning community.

6. Administration

a. Each center should have a director who meets the following general criteria:

(1) Superior competence in research on both educational media and learning.

(2) Extensive experience in developing and administering programmatic research on human learning and related behavioral science areas.

(3) Ability to maintain for himself and his staff a broad, long-term and clear perspective of the program and its research objectives.

(4) Willingness to commit himself fully to long-term programmatic research on meaningful human learning.

(5) Ability and motivation for active participation in the research, and not merely an interest in the management of a research project.

b. Each center should have an administrative assistant or business manager of outstanding ability who will administer business, finance, sub-professional personnel, and such other matters as may be delegated to him. He should have both administrative and advanced research experience so that he can administer and understand a complex research enterprise of broad scope.

c. The research staff of each center, through an executive committee composed of the director, the administrative assistant and at least four members of the research staff (or the principal investigators in large centers), should be responsible for developing research plans and programs to achieve the objectives of the center. It is important that the research staff be given considerable freedom, within generally defined areas of research, for determining the kinds of programs and projects that would be conducted.

d. An advisory board should be established within each region where a center is located. The membership of this board should be drawn from the faculties of cooperating public schools and colleges within the region. The director of the center should serve as chairman of the board. The board would not determine the nature of the research to be performed by the staff of the center; rather, it would suggest possible areas of research, call attention to problems in education to which research findings might be applicable, serve as a liaison between the center and its partners in the region, arrange for the participation of the cooperating schools and colleges in research, where appropriate, and generally work toward the end of supporting the programs of inter-institutional cooperation. It will also facilitate the flow of information to and from the centers.

e. A national advisory council should be established, consisting of: the directors of the regional centers, representatives from the sponsoring Federal agencies, and one representative from each of the principal professional organizations importantly involved in research on human learning, e.g., National Academy of Sciences, American Sociological Association, American Psychological Association, American Educational Research Association, Division of Audio-Visual Instruction, American Council on Education, etc. The chairman of the national advisory board should be elected from the membership of the council. The functions of this council would be essentially the same as those of the regional boards, except that its perspective would be national in scope. In addition, the national advisory council would periodically evaluate the work of each center as well as the overall effort. (See section on Assessment and Evaluation, pp. 91 - 93 .)

7. Divisions of a Center

A typical, large center may include several functional sections, e.g.:

a. The "thinkers" -- "people with research ideas", theoreticians, people who know what is known and what needs to be investigated in the generally defined areas.

b. Experimental design, measurement, mathematical quantification, test construction and data analysis and processing section.

c. Research projects implementation section.

d. Information resources and dissemination service.

e. Instrumentation, facilities, operations and development service.

f. Production of stimulus materials (media).

g. Writing and publication section.

h. Development and "field testing" staff.

i. Supporting staff, administrative, clerical, secretarial, accounting, etc.

j. Professional, educational and public relations section.

8. Research and Supporting Staff

The staffing of each center is the most vital of all problems for it is axiomatic that research talent of extraordinary quality will be required to conduct the level of research which is needed so urgently in education.

Several conference participants have wondered whether a satisfactory pool of talent is available for staffing the centers. Others have expressed the view that the long-term trend will result in the most able professional men becoming staff members or associates of the research centers, particularly if the centers are closely and effectively integrated with the academic community. The study shows that there are many people who would welcome opportunities to be associated with the centers as outlined in these plans. However, it will still be necessary to recruit, train and develop personnel for the centers as they are established and expanded.

a. Levels and Types of Staff

Certainly, the nature of the staff of any particular center would depend upon the mission of that center; however, each center probably should have three general types of personnel: research and development, operations support, and administrative-fiscal. Given the interdisciplinary nature of the research, a center may have a research staff drawn from several of the following: educational sociology, educational psychology, experimental psychology (i.e., human learning, perception, motivation, personality), child development, educational research, philosophy of science, instructional media, engineering, mathematics, statistics, learning technology, behavioral biology, and systems simulation. Support personnel would be drawn from the technical levels of several of the same fields but, in addition, might include specialists in instrumentation, media production, neurology, physiology, computation, computer programming and the like.

It is assumed that the research staff would consist largely of junior scientists working with and under the direction of a few senior scientists. Paul L. Dressel has suggested that much of the staff be young for,

> "Assuming that the initial activities of such a center may be very much in the direction of defining problems, and that the most productive research may not come for a number of years, it seems highly important to find a number of able, young individuals for the staff of such centers rather than the outstanding names . . . ."

b. Size of Staff - Core, Professional and Supporting

Centers should be permitted to vary in scope of research undertaken and in level of financing, hence in size of staff. Furthermore, many of the conference participants suggested that there be a relatively small permanent full-time core staff for each center and a much larger number of part-time and temporary research personnel.

Estimates of the minimum size of the full-time professional staff have ranged from five to twenty five people, with the smaller number being favored for the initial development phases. The part-time and temporary research staff was estimated as being approximately four to one relative to the number of core staff members. Consequently, the minimum professional staff for a center would be twenty-five, plus the director and the administrative assistant. This group would include permanent research scientists, scientists on leave from other institutions, scientists on part-time appointments from cooperating schools and colleges, and advanced graduate students engaged in dissertation or post-doctoral research.

It was estimated that the minimum support personnel would also be in a ratio of approximately four to one relative to each full-time member of the core staff. Secretarial, clerical, and fiscal personnel in a minimum center, therefore would be approximately twenty.

Given these estimates, the minimum (professional and supporting staff) of all levels and types in an average center will be forty-five to fifty people. In a large center, e.g., one with a core staff of fifteen scientists, the total staff would be in the range of one hundred and twenty-five to one hundred and fifty full-time, part-time and support people. It is recognized that the build-up of staff must occur over an interval of three to four years and that the kinds of research and development work undertaken will affect these estimates.

c. Recruiting

A problem of considerable importance is how a center should proceed to obtain a core staff of high quality, for our information sources believe that the success of a center is likely to be decisively determined by this staff quality factor. The consensus is that "good people in a first-rate research environment will attract more good people." The selection of a director is a critical first step and conference participants generally felt that a center should be developed only where a person of the quality desired is available in the host institutions or when the responsible institutions can give assurance that a specific qualified person is available. Some men have expressed the view that once a qualified director has been selected, the recruiting problem can be solved even at the present time when there are severe shortages of the kinds of research people needed. As encouraging as this opinion may be, other factors must be considered.

To attract and hold a core staff of high quality a number of inducements and incentives in addition to the drawing power of working with a distinguished director will be required. Some of those that have been suggested are:

(1) Excellent research resources, e.g., "ideal" physical facilities and instrumentation, and the actual availability of suitable populations for testing.

(2) Salary levels which are competitive with other scientific and professional fields and which enable an investigator to devote all of his time and talents to research and development work. The research staff should not be obliged to search for "hidden subsidies" because their salaries are inadequate. Furthermore, they should be protected from "outside" demands on their time.

(3) Reasonable freedom to pursue one's own research interests within the defined areas of the objectives of the center.

(4) Freedom from the responsibilities of administrative details and excessive institutional involvements.

(5) An opportunity to engage in research on significant theoretical and practical problems in a manner and in a setting which maximize the probability of achieving important results.

(6) The stimulation of working with several highly qualified colleagues on similar problems.

(7) Availability of adequate support personnel and services.

(8) Continued and sustained support free from the usual problems and fears associated with working from grant to grant.

(9) Appropriate professional and academic status accompanying some form of continuing academic identification.

For some members of the core staff joint appointments between the center and the academic disciplines of the institutions will be necessary. This procedure also will help in making the center an integral part of the institution and serve to facilitate greater cooperation in research and graduate training between the cognate disciplines and the center. Other members of the core staff may prefer an appropriate title within a vertical hierarchy of the center, e.g., research professor, research associate, junior scientist, senior scientist.

d. Additional Research Personnel

After the core staff and support staff have been assembled, other research personnel can be engaged by:

(1) Providing advanced graduate students from the participating universities with excellent opportunities for dissertation research on significant problems.

(2) Inviting both mature scholars and their junior colleagues to work at the center while on sabbatical leave or with support from one of the post-doctoral programs.

(3) Making part-time appointments to the center from the faculties of the host or other participating colleges, universities, and schools.

(4) Providing summer research opportunities to selected undergraduates, graduate students, faculty members and public school personnel.

These sources and types of research staff make it clear that each center should assume a major responsibility for training individuals for a new discipline concerned with complex human learning, media, and learning technology. Within a few years of its inception, a center should be able to "export" research personnel, some of whom would become members of the core staffs of newly developing centers. The possibility of moving from one center to another would probably be attractive to those junior scientists who desire breadth of training.

It is very probable that in long-time perspective the research centers will become the sources of uniquely trained and distinguished men qualified for appointment to the faculties of schools, colleges and universities.

9. Facilities and Instrumentation

Conference participants, writers of resource papers, and others consulted during this investigation are in agreement that most of the centers must have a physical plant carefully designed for maximum flexibility in space utilization. The amount and types of space required will vary with the mission of a center. One or two centers may require only limited conventional space, while one or two may require "a school of the future." Some suggestions for physical plant facilities which have been made are:

a. Media library

b. Reference library with an information retrieval system

c. Shop and instrumentation facilities

d. Observer space -- with one-way vision glass

e. Special classrooms with adequate instrumentation

f. Laboratories with instrumentation

g. Space for studies of groups and space for studies of individuals

h. Stimulus deprivation environments

i. Stimulus enrichment environments

j. Space, including living quarters, for visiting researchers

k. Mobile laboratories with instrumentation. These would be loaned to stations, to other centers, and used for work with special populations of subjects. This would help to add a dimension of realism to the research.

l. Special rooms with movable floors, ceilings and walls, including a room within a room, which could be tilted as desired, and which would be completely sound proofed and elaborately instrumented, with ample room under the floors to permit the installation of new equipment without affecting the classroom environment.

Instrumentation also would vary with the mission of a center and so would vary greatly in amount and type.

Instrumentation should provide the possibility of recording and measuring many conceivable outputs from the student: specifically, oral, verbal, dial, typewritten, gestures, eye and other physical movements, both of individual and groups of individuals in classes of units of one student to hundreds of students.

It should provide the possibility of supplying input data to the student in all conceivable ways which would be accepted without medical supervision. Moreover, the center should be equipped with data processing devices which are capable of storing and analyzing the student input and output data in real time, and display the results to the student and/or instructor--all, or in part.

It is recommended that the instrumentation of the centers be done in two steps: first, adapt currently existing components to the special needs of learning research; and second, design and develop new components which have not been conceived in a design sense. A possible example of the latter would be an all electronic display system with random access, digitalized video and audio-stores.

A list of some of the desired components would include:

(1) Response recording equipment.

(a) Electrical for use with buttons and dials.

    - (b) Photographic.
- (2) Display system.
    - (a) Random access audio and video material.
    - (b) Paced oral and video displays.
- (3) Reinforcement displays: oral, written, and pictorial.
- (4) Computerized data storage and data retrieval system.
- (5) Data processing equipment which can be integrated with the other instruments.
    - (a) A unit of this system should operate in real time, so that the input can be controlled by an analysis of previous responses.
- (6) Television observation -- with remote control cameras which can take individual or group pictures of any or all students.
- (7) Communication links to substations by closed-circuit television; computer controlled on microwave lengths.
- (8) Lecturn with automatic control of visual displays, and a television camera underneath, so that written and pictorial displays may be recorded on video tape.
- (9) Chairs with micro switches for the measurement of students' motions.
- (10) Chairs with glass arms containing a charge detecting system to determine note-taking activities versus time.
- (11) Media production and distribution facilities.

In summary, the design of entirely modern, new and advanced research centers, as visualized by those who provided information in this study, clearly presents a most complex and challenging problem. It is evident, however, that advanced electronics systems engineers, architects, media and instrumentation specialists and learning research specialists are prepared to attack this design problem. Furthermore, it is clear that if significant advances are to made in the science and technologies of complex human learning, the necessary facilities and instrumentation must be provided.

10. Dissemination of Research Findings

It is mandatory that careful attention be given to the flow of information to and from centers if the research results are to have immediate and desired effects on educational practices. The usual means of communicating research results, i.e., journal publication and presenting papers at professional meetings, are too slow and ineffective to be depended upon exclusively. The other media should be used extensively in addition to print. Educational television and radio facilities within a region should be made formal partners in the dissemination of results to the several publics of the educational community and indeed to those of the nation. Demonstrations, where appropriate, should be strategically located in the prestige schools of a region. A close working relationship with the Regional Educational Development Organizations will have to be maintained. As suggested in the section on organization and administration, the regional and national advisory boards will facilitate the work of the centers in stimulating the flow of information and influences. The learning research centers and the Regional Development Organizations probably should be linked together with a rapid communication system such as Dataphone.

Furthermore, it is expected that much effective dissemination of research results will occur as the result of the involvement of faculty members from public schools and colleges in the planning and carrying out of specific research studies.

E. Criteria for Location of Centers

The criteria for the location of centers for research on meaningful human learning, arranged in an approximate order of significance, are:

1. Location on, or close to a university campus to provide:
    a. The necessary intellectual climate
    b. The opportunity for joint appointment of staff in academic departments

   c. Research and support personnel on a part-time basis

   d. Advanced graduate students

   e. A prime source of consultants

   f. Related technical and scientific facilities.

2. Availability of Competent Personnel:

   Those present at the institution where the center is to be located and those who can be brought to the center. In effect, the principle is "the presence of able persons, who in turn, will attract other able people to join them."

   As stated by the President's Science Advisory Committee:

   > "The central proposition of this report is that science and the making of scientists go best together. This means that when it can be managed, basic research should be done in, or at least in association with, universities."[1]

3. The universities selected should have certain traditions:

   a. A history of competence in research on media and human learning.

   b. A history of support of, and participation in, such research, on the part of related disciplines.

   c. Willingness of all levels and organizational units of the university administration to accept and to give enthusiastic support to long-term, programmatic research.

   d. Strong graduate programs, preferably at the doctoral level, in related disciplines such as instructional media, educational research, psychology of learning, educational sociology, and educational administration.

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[1] Scientific Progress, The Universities, and the Federal Government, Statement by the President's Science Advisory Committee, The White House, Washington, D.C., November 15, 1960, p. 20.

4. Some of the schools and colleges of a region should have a tradition of willingness to cooperate in experiments with educational media and instructional methods. The center should be designed to include plans for cooperation with these groups.

5. Actual access to a wide range of appropriate subject populations for experimental purposes.

6. Existence of media production and distribution facilities on the campus or in the campus community.

7. Existence of potential technical resources such as those which could be provided by schools and selected types of industry.

8. Strategic placement within a region for easy and rapid communication between the center and the schools and institutions of the region.

9. Geographic relationship of the center to problem areas under investigation. Not all centers should be in close proximity to an urban area. Some should be placed in rural areas. The important principle is to place centers strategically to capitalize on the wide range of special subject populations, e.g., Puerto Ricans in an urban area, migrant labor in rural areas, technologically displaced persons in both rural and urban areas, the culturally deprived in both rural and urban areas.

10. Some degree of population diversity within the region.

11. The relative costs and availability of space should be considered where specialized physical plant must be constructed.

There exist, in the areas of the nation covered by this study, strong and increasing personal and institutional preparedness to cooperate with sponsors in developing centers. It is the judgment of the planning group that there are enough competent men, now working where centers might be initiated to provide the necessary leadership. Given sufficient funds, the proposed plan can be put into the development phase.

So many possible locations exist, that the crucial problems are those of selecting the best sites for the number, size and kinds of centers that can be financed, and where the dispersed resources of the regions can be mobilized.

F. Evaluation and Assessment of the Centers

The evaluation of any long-term programmatic research enterprise is an extraordinarily difficult task. Many questions currently are unanswerable in objective terms. What, for example, is a productive research program? What magnitude of change in educational practices must occur to be considered significant? Who must adopt the results of research and what must they do with them for the research results to be considered important? How long should a center be permitted to operate before significant results can be expected?

It is suggested that the chief agency of assessment consist of a panel of scientists made up of the directors of the centers and such other scientists and administrators as are needed. The continuing evaluation panel will serve especially to assess the research program of each center relative to its defined mission and objectives. The first evaluation of a center should be made two years after its establishment and at three-year intervals thereafter. An evaluation of the social impact of the centers should be made by a team of appropriate educators and scientists every five years.

Centers should develop and apply systematic methods for their own evaluation so that, in the main, the panels would need only to review the results and assist in the formulation of judgments about policies, procedures, effectiveness and productivity.

However accomplished, the evaluation will need to be made with reference to a set of criteria exemplified by the following points of consideration:

1. Productivity relative to invested resources - - considering both the quantity and the quality of results.
2. The kinds of problems being attacked - - originality, difficulty, breadth, number or scope, promise of theoretical or practical yield, etc.

3. The efficiency of the center in the use of time, people, facilities and space, and the potentially available resources and services of the institutions and of the region.

4. Characteristics of the center in terms of the support of the research and development environment for the mission.

5. Staff morale and motivation for achieving the center's accepted objectives.

6. Inter-institutional relations, including those with the Educational Development Organizations, and their effects on research and development programs.

7. The effectiveness, including the rate, of transmitting proven results into accepted educational practices of the region in (a) schools, (b) institutions of higher education, (c) community educational agencies; and the effectiveness of transmission through Educational Development Organizations and other similar agencies, to national professional and public groups.

8. Responsiveness of the center to the important educational problems and issues, and awareness of the significance of its research mission in these areas.

9. Interdisciplinary professional respect and prestige earned by the center.

10. Contributions to advanced graduate and post-doctoral training and the training of human learning research scientists.

11. Accomplishments in developing the full competencies of the center's own research staff, including part-time and visiting investigators.

12. The impact of the center in increasing in its region the awareness and concern for increasing the quality of education and of developing balanced perspectives and understanding of the role of research and development in this endeavor.

These points of evaluation demonstrate that the plan for the centers requires that they measure up to very high performance requirements in order that they shall contribute to the advancement of the science of human learning as a basis for the improvement of the quality of the nation's educational enterprises.

V. FINANCES

A. Estimates by Type of Center

The estimates of the ranges of costs for establishing and operating the centers vary greatly according to mission, size of staff, type and quantity of space, geographic location of center, and the types and amount of instrumentation. The more knowledgeable and experienced information sources have suggested the plan provide for variability in size, type of physical plant, and amount of instrumentation. Thus, some centers could (a) be administrative only, (b) have no elaborate requirements for specialized space or unusual instrumentation, and (c) be financed at a level of about $250,000 per year. At the other end of the continuum it has been suggested that at least three special-function national centers should be developed with an investment in physical plant and instrumentation of eight to ten million dollars with an annual budget of about two and one half million dollars.

Practically all sources of estimates have urged long-term financing, a minimum of five years with ten years preferred. The principle of sustained support takes precedence over the principle of massive support, although both are required for maximizing the probability of highly significant research results.

The review of extensive evidence and information has led the planning group to formulate the following summary judgments:

First, that agencies of the Federal Government would be justified in allocating one hundred million dollars for the establishment, build-up and operation of the twelve human learning research centers during the next four years.

Second, that thereafter Federal funds in the amount of twenty-five million dollars annually could be justified to provide the basic part of the centers' operating costs.

In order to provide examples of patterns of centers in various sizes, three different types are described below and estimates given of their costs.

1. Type I. This type of center would conduct programmatic research in one of the defined major areas (pp. 40 -44). It would attempt limited interdisciplinary, developmental and cooperative work in the immediate region. This type of center should be assured of continuing financial support by grant or contract for five years. Type I centers will not require special buildings, facilities and complex instrumentations. The program would be reviewed and evaluated during the third year, and decisions made relative to the following alternatives:

   a. Discontinue after the 5th year.

   b. Maintain support at the same level.

   c. Continue the research program and increase financial support.

   d. Convert and expand the program to a Type II or Type III center.

   General Estimates of Costs for a Type I Center:

Annual average operating costs	$ 250,000
Total committed costs for 5 years	$ 1,250,000

2. Type II. This type of center would conduct regional research and development programs in several of the defined major areas. It would be responsible for conducting basic and applied research in these related areas, and for effecting interdisciplinary, inter-institutional regional cooperation. The center would work closely with an Educational Development Organization over its defined region. This type of center would be assured of continuing financial support, with the first commitment covering five years, contingent upon congressional appropriations. Type II center will require special buildings, facilities and complex instrumentation. The recommended periodic and self evaluations would be conducted to improve and guide the operation and the development of the center.

General Estimated Costs for a Type II Center:

Annual average operating costs	$ 750,000 to $ 1,250,000

Operating costs for five (5) years	$3,750,000 to $ 6,250,000
Buildings, facilities and instrumentation	$3,000,000 to $ 5,000,000
Maintenance, modifications and expansions (20 percent)	$ 600,000 to $ 1,000,000
Total Costs for five years:	$7,350,000 - $12,250,000

3. Type III. Type III center would be a unique national research and development effort for investigating systematically complex problems of human learning. The research areas would be those which can only be studied adequately by relatively large scale and sustained efforts. Such efforts also require special organization, buildings, equipment and advanced systems of instrumentation which may include computers of special types, new kinds of display systems and media combinations, information and data storage systems, "feed-back" capabilities and rapid data processing - all integrated with learning activities. The Federal government, foundations, industries, including the communications industries, may support this Type III center. The results of research would be made available rapidly and on a national basis.

General Estimated Costs for a Type III Center:

Annual average operating costs	$ 2,000,000 to $ 2,500,000

Operating costs for five (5) years	$10,000,000 to $12,500,000

Buildings, facilities and instrumentation	$ 8,000,000	to	$10,000,000
Maintenance and modifications(10 per cent capital cost)	$ 800,000	to	$ 1,000,000
Total costs for five years:	$18,800,000	to	$23,000,000

B. Sources of Financial Support

The learning research center concept as outlined above so urgently needs implementation, has so much justification, and deeply interests so many Federal agencies and other sources of funds, that it is reasonably certain that the plan will have many sponsorship possibilities.

The first step of establishing the centers is the most basic, critical and difficult. When this first action has been taken and centers are established, then funds from many sources will support their development, expansion and operations.

It is known that some of the great foundations are interested in supporting the kinds of research on learning that can be conducted only by such centers as are proposed by this plan. Large industries and their educational agencies are actively interested in providing support of several kinds and in cooperating with such centers as are proposed. State educational agencies would find the organizations and facilities of the centers useful means for accomplishing the research that they cannot now undertake. Universities, it is believed, would be interested in shaping their research and building programs in order to give logistical support to the centers.

Several Federal agencies have developed proposals and plans for launching and operating behavioral research centers which resemble in some respects the patterns and scope of the proposed centers. Therefore, when the centers are established, or perhaps even for founding them, inter-agency cooperation may be developed.

In this connection it is pertinent to cite The National Defense Education Act of 1958. In Title X - Miscellaneous Provisions, Section 1001. (e) the Act reads,

> "Any agency of the Federal Government shall exercise its functions under any other law in such manner as will assist in carrying out the objectives of this Act . . . "

The proposed plan is based on the assumptions that the United States Office of Education has the authority and responsibility for conducting research and development in the area of the science of learning supportive of education, as exemplified by the Cooperative Research Program, Title VI of National Defense Education Act for language development research, and Title VII for research and experimentation in media related to education.

The assumptions basic to these plans also hold that functions of centers related to information dissemination such as reports, development activities and their observations by practical educators and teachers are authorized under Title VII, Section B, and other authorities of the U.S. Office of Education.

It is assumed that the centers in adequate numbers and scope can be established under authority already given the Commissioner and that funds available from several U.S. Office programs could be combined to establish and support them. It is believed that other Federal agencies, such as the National Science Foundation and the National Institute of Mental Health, and others could pool funds for such centers as was done, for example, for Project Talent. Furthermore, it is believed that the Congress will react favorably to the research center plan. This concept is involved to some degree in the Quality Education Bill - S. 2826, Title II, Section 201 and especially 202. Furthermore, new legislation and/or appropriations of additional funds may be viewed favorably by Congress.

It is noteworthy in this connection that the bi-partisan House of Representatives' Advisory Group on Higher Education of the Committee on Education and Labor on January 22, 1962 made several recommendations supportive of the plan for centers (17). The Advisory Group recommended increased grants and loans for academic constructions, increases in funds to the National Science Foundation for science teaching facilities, and matching funds to colleges and universities for language teaching equipment. Of more pertinence to the plan being presented, under Section V. Basic Research to Improve Learning and Teaching, Recommendation 12 states:

> "That the Committee on Education and Labor give special attention to ways of fostering high-quality basic research on the learning process with a view to improving the effectiveness of teaching and learning at all levels and that hearings be held on this subject at an early date."

The Committee summarized its views in the following statement:

> "The group found widespread agreement among the panelists that there is an urgent need for basic research in the learning process as distinguished from applied research in education. The resources going into basic research in education are insignificant compared to resources going into research designed to improve health or physical standards of living. At least until recently, basic research in the learning process has apparently not attracted the attention of the most able behavioral scientists.
>
> "The group is convinced that a major effort should be made to channel more resources into high-quality basic research in education. . . ."

In summary, the study which has been made leads to the conclusion that support for centers appeals to and is congruent with interests of foundations, industries, Federal and State Government Agencies, and that the U.S. Office of Education probably has the authority and responsibility necessary for launching the centers. Interagency cooperation in this field may be possible. Furthermore, there seems to be developing in the Congress strong and favorable interest in research on complex learning basic to education.

VI. REGIONAL FEASIBILITY STUDY

The terms of the contract required that Penn State "make an initial test of feasibility of the plan by collecting evaluative comments from institutions and agencies in one or more service areas in which such a proposed center might operate."

To meet this requirement a two-day conference was held at University Park, Pennsylvania on March 16 and 17, 1962. The meeting included representatives from thirteen institutions of higher education in the Middle Atlantic Region, as well as representatives from the Pennsylvania Department of Public Instruction, the United States Office of Education, and from interested industrial groups. (See list of participants, pp.5-7).

After hearing a report of developments to date including a description of the emerging plan for centers, the conference participants considered briefly the general concept of media learning research centers and moved to specific questions relating to the possible establishment of one such center in the Middle Atlantic area. As examples of sustained programmatic research the conference heard and discussed reports on the financing and operation of large and continuing research programs in other fields which receive a major part of their support from the Federal government. These examples included the Ordnance Research Laboratory, Agricultural Experiment Stations, Primate Centers, and Materials Research Centers. These papers gave eloquent testimony to the functional efficacy of massively supported centers. They indicated too, that Federal support does not necessarily bring with it a constraining Federal control.

Having approved the justifications for research centers as developed in earlier conferences, the participants accepted in principle the concept of a pilot center for the Middle Atlantic area. In doing so they emphasized that the developmental phase of the total operation would require from twelve to eighteen months of intensive effort. In this period necessary action would be taken to define the broad research areas of the center, to staff and equip the latter, to design its research program and mode of operation, and to develop the necessary institutional relationships and cooperation.

Furthermore, it would be necessary to make arrangements both for conducting research and for applying the findings in schools and institutions of higher education.

The conference decided that the represented and interested colleges and universities of the Middle Atlantic Region take prompt action to implement the conclusions stated above. To that end as a test case the following resolution was approved:

> "That the planning group appoint a committee of five people to prepare a statement of center objectives to go to presidents of colleges and universities to obtain their initial commitments and concurrence in principle to the concept of a cooperative learning research center in the Middle Atlantic Region."

Acting on this directive, an appointed committee, including Dr. John Adams of Temple University, Dr. James Coleman of the Johns Hopkins University, Dr. John Geise of the University of Pittsburgh, Dr. Richard Rippel of Cornell University, and Dr. Wendell Smith of Bucknell University, met immediately after the close of the conference and drafted in the form of resolutions a statement of objectives.

On March 20 the following statement was forwarded to the heads of the colleges and universities represented at the conference for their concurrence:

> "Whereas, the need for vastly increased research in meaningful human learning has been sharply highlighted by recent actions of the Congress in appropriating funds for research and education in the areas of juvenile delinquency, development of adequately trained labor resources, and retraining of technologically-displaced persons, and
>
> "Whereas, the urgency of the Nation's need for additional validated knowledge of the learning processes is so great as to necessitate major concentrations of resources at a level beyond an individual university's capability, and
>
> "Whereas, this additional knowledge will be needed on a continuing basis and in such form as to enable its prompt utilization by the schools of the Nation, and

"Whereas, much of the research that is called for requires instruments and facilities which, because of cost, can be provided at only a few locations, where, however, they may be used by researchers from many locations,

"We, the undersigned, endorse the concept of university cooperation in a continuing program of research in the area of meaningful human learning, and accordingly,

"Each of us does hereby agree to designate an appropriate representative to serve as a member of an implementing organization resulting from affirmative action by appropriate Federal agencies to achieve this objective.

"Name ______________________

"Institution ________________

"Date ______________________ "

Individuals who attended the conference agreed to present the resolution to the heads of their institutions and to provide whatever information and clarification would be necessary.

The conference discussed at length the relationship of media research to the broad field of learning research. A resolution was formulated expressing the consensus of the group:

> "That to conduct research which would be exclusively in the context of the new media is undesirable and would lead to incomplete findings. This study has shown that while research on the newer media should be a part of the activities of the proposed research centers, the research activities ought to be considered in the broader context of research on meaningful human learning."

In passing this resolution, the conference did not minimize the need for additional media research. Rather, it was felt, that to include media research within the context of a major assault on fundamental learning research problems will help improve media research, qualitatively and quantitatively.

Although aware that grants under Title VII are of necessity restricted by the terms of the National Defense Education Act, the group nevertheless hoped that the United States Commissioner of Education would take a broad view of the total research problem and would exercise his authority to organize support on the scale required to advance the learning research center concept. The recent administrative reorganization within the United States Office of Education, involving the joining of the Educational Media Branch with the Cooperative Research Program under one divisional head, was viewed as one development which might facilitate the required action.

The expressed interest of the Middle Atlantic colleges and universities in establishing a cooperative regional learning research center demonstrates the feasibility of establishing such a center in this region if the program recommended in this report is approved.

In conclusion, it should be observed that within a very brief time the concept of regionality was put to a severe test and accepted, and positive preliminary actions were taken.

VII. IMMEDIATE ACTION POSSIBILITIES

Extensive thought and discussion have been concerned with what immediate actions might be taken, first by the Staff and Advisory Committee of NDEA, Title VII, second, by the new Research Branch of the U.S. Office of Education, and finally by the Commissioner of Education working cooperatively with other interested Federal agencies.

At this time the drafters of the "generic" plan for centers must confront limitations on the possibilities of immediate action as determined by legislation, administration, available funds and the conditions and potentialities for research and development described in this report.

Therefore, let it be assumed, as a minimum, that one million dollars per annum is available and could be committed by grants or contracts, on approval by the Advisory Committee, for the purpose of initiating Regional Media-Learning Research Centers; then what can be done now?

The following immediate actions are suggested:

1. That the Title VII Advisory Committee approve the initiation of centers by recommending the establishment of four (4) Type I centers of research. (See p. 95)
2. That the Advisory Committee, acting within limits of its authority and responsibility and by established procedures, approve or recommend immediate negotiation of agreements with appropriate universities or their representatives for programmatic research on one or a combination of problems in the following research areas as previously described which are largely concerned with educational media:

    Area 1. Analysis and Dissemination of Existing Knowledge, (See p. 40-41)
    Area 5. Stimulus Material (Media) and Structures of Knowledge, (See p. 42)
    Area 6. Learning Sets and Skills, (See p. 42)
    Area 9. Computer-Based Learning, (See p. 43).

3. That the four Type I research centers be established on a regional basis in the Middle Atlantic, Mid-West, West Coast and Southern regions of the country, and that proposals be invited for this purpose.

4. That four million dollars be committed to cover the cost of operations for the four above listed research centers for the next four years.

5. Finally, it is suggested that appropriate actions be taken to pool the resources for research (those now available, and those that may become available) in the new Research Branch of the U.S. Office for expanding the immediate action possibilities outlined here.

The planning group estimates that final proposals and agreements can be developed and could be ready for review by a sub-committee of the Advisory Committee, or by the entire Committee, before June 10, 1962. Therefore, it is suggested that, in view of the significance of this development for education and media research, the Advisory Committee plan for a special meeting on or about the 10th of June, 1962 to act on these proposals.

Further and justified actions for developing additional centers, and for increasing their scope are included in the following section on Conclusions and Recommendations.

VIII. CONCLUSIONS AND RECOMMENDATIONS

A. General

1. The development of a science of human learning, supportive of the practical arts of education, is an essential approach to solutions of many of the nation's most critical problems. Therefore, greatly increased financial support for both existing and new kinds of sustained learning research programs for this science is justified.

2. It is recommended that during the next four years appropriate agencies of the Federal government invest $ 100,000,000 for the establishment and operation, in cooperation with universities, of regional learning research centers. In addition, the Federal government should invest $ 25 to $ 40 million annually for the following five-year period to cover their basic operating costs. The importance of human learning as a field of scientific investigation, the primitive state of knowledge about learning processes, the probable significance of results from research on learning for education, considerations of national security, growth and economy, all justify this investment.

3. Twelve centers should be established during the next four years, nine of them to be located in the regions of the proposed Educational Development Organizations and three national special-function centers to be located wherever they can be most productive (possibly near several universities).

4. The size of centers, their rate of development, the kinds and scope of their research programs shall be determined by the needs for learning research and by the resources that can be mobilized, especially personnel, for developing the centers.

5. The regional centers shall be responsible for conducting high quality basic research, and for involving the regions' educational communities at all levels in applied research and educational development programs.

6. The centers shall develop by all appropriate means new strategies of research, interlocked with new strategies of educational developments, to ensure the rapid and effective use of tested knowledge in the regions' schools, colleges, universities and other educational enterprises.

7. Agreements shall be negotiated and stated in the founding documents for the centers as to the areas of research in which each center shall concentrate its research efforts.

B. For the United States Office of Education

1. The U.S. Office of Education should combine, coordinate and focus, to a greater extent than is done currently, its several research programs on meaningful human learning.

2. A considered balance of emphasis, designed to increase the quality, productivity and significance of the Office's efforts to aid education, should be achieved between (a) basic and applied research and (b) educational developments and services.

3. The U.S. Office should consider contracting with an appropriate organization, such as the National Academy of Sciences, the Smithsonian Institution, the American Council on Education or the Brookings Institute, for making a thorough analysis of the interests and the possible resources of Federal agencies, foundations, business, industries (including the broadcast, publishing and communications industries) for supporting a national complement of human learning research centers similar to those described in this report.

4. The U.S. Office of Education should provide leadership, encouragement and plans to State educational agencies recommending the budgeting of one half of one percent of their budgets for basic and applied research to support State programs of educational developments and services.

5. The present research programs of the U.S. Office should be continued and strengthened, and the center-based, cooperative, programmatic and regional research as outlined in this report should be

complementary to the current research efforts.

6. The legal status of legislation for authorizing sponsorship of the proposed centers should be studied, and if required, new legislation should be drafted and proposed to the Congress.

C. For Title VII

1. Research on media should be broadly planned and conceptualized as a system including the other major components of factors and functions which directly affect meaningful human learning. This will be necessary in order to retain and to attract to the field the most competent investigators and increased resources and thus to advance importantly the science of learning including the understanding, development and use of all appropriate media.

2. The definitions and examples of media as stated in Title VII should be legally changed if necessary, or reinterpreted, if possible, to include the full range of stimulus materials and information displays, for example, print, learning laboratories, controlled learning environments, computer systems for research on and the regulation of learning. The research should be broadened to include the investigations of the structures and orders of information in relation to the stimulus materials for learning.

3. The rapidly developing technology of education, which so importantly involves instructional media and materials should be strongly supported. The Staff and Advisory Committee of Title VII should employ all possible means to encourage the application in this development of what is known with confidence and can be discovered by research about complex meaningful human learning.

4. The Advisory Committee of Title VII should approve immediate action recommendations for establishing by June ,1962 ,four programmatic learning research centers as first steps in initiating the plan outlined in this report.

5. The Staff of Title VII, assuming favorable action by the Advisory Committee, should (a) invite proposals from the regions specified, to be summitted by June 1, 1962, (b) work through established and appropriate educational organizations, (c) consult with appropriate groups for developing proposals, (d) arrange site visits by a special committee of three men to possible regional locations. This committee should prepare recommendations for the Advisory Committee on the establishment of the first centers.

6. There should be appointed in the U.S. Office, Research Branch, a staff member whose responsibility would be the monitoring of the implementation of the adopted plans for the centers.

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APPENDIX 1

Resource Papers

PLANS FOR ESTABLISHING REGIONAL LEARNING RESEARCH CENTERS

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When one realizes how little we really know about the nature of human learning, and especially how little attention has been given by college and university professors in subject matter fields to the learning process, it is surprising that we do as well as we do in education. It is hardly to be expected that even concentrated investigation of human learning will, in any short period of time, enable us to predict with any high degree of certainty what will happen to each individual student. It is, however, certain that unless we give our concentrated attention to the matter of learning and to analysis of the ideas which are to be learned in order to bring greater efficiency into the learning process, the amazing increases in knowledge will shortly result in it becoming impossible for any one individual to become much more than a narrow specialist. Certainly one way to obtain concentrated study of the learning process would be to set up regional learning research centers.

Justifications for Establishing Regional Learning Research Centers with a Programatic Orientation

Much of the research that goes on is individually developed and in no way related with other research in the same field. This may overstate the case but, unless research projects are carefully planned in relationship to each other, it is very difficult to combine them in any meaningful way to obtain significant generalizations. While some worry is commonly expressed that programatic research may suppress creativity and force individuals into patterns, this perhaps is less the case than is commonly feared. Most individuals planning a research project are, at different stages of their planning, open to suggestions and might go any one of several different directions in the details of what they do and how they do it. Little harm can result from the decisions being made in such a direction as will relate the next piece of research to what has gone before and what else is being planned at the same time and for the future. Thus the main advantages of continuing research programs with a programatic orientation are:

1. The assurance that continuing research is being carried on.

2. The various pieces of research at any one time or in sequence are so interrelated as to make it possible to draw conclusions based upon the total set of research activity.

3. There is much more likely to be recognition of developing gaps in the research program and a definite attempt to cover them; whereas, in individual research, either lack of interest, lack of money, or other considerations may result in repetition of several pieces of research in the same general area but complete neglect of some major issue which would be needed to tie together several pieces of research.

No doubt extensive programatic research will run into some difficulties growing out of the fact that coordination of a numer of different individuals and a number of different disciplines is involved. Experience with other interdisciplinary research and with other organizations involving a large number of research people indicate that this is not likely to be serious. Another problem may arise in connection with the specificity of learning. Will it be necessary, for example, to study a particular learning problem in relationship to learning science, then in relationship to learning mathematics and, in succession, art, music, mathematics, foreign language, and the like? One hopes that this is not the case, but only extensive research is likely to make clear whether general principles can be attained which provide guidance to teachers and others in all the various fields in which we are concerned about learning. Still another problem will be found in experimentation. Much of our learning in the school situation is with sizeable groups of students where many factors are involved and where adequate controls are hard to obtain. Here, a well-financed center with a fairly large staff representing the various disciplines will afford a real advantage in planning and carrying through experimentation, with full awareness of and with every attempt to measure or control the many variables involved.

It seems likely that such research centers will be most productive if they first concern themselves with basic studies in the area of learning. Much of the research that has been done in the context of established educational programs has been oriented to a particular problem or need and, hence, does not lend itself to the formulation of general principles. A research center, however, which is divorced from the immediate need of answering questions or making decisions about educational programs may proceed with a more carefully planned program studying the basic nature of the learning process. On the other hand, research centers should keep in contact with the actual problems of learning and, being regional or national in scope, should have access to a large variety of programs and experiences, making it more easily possible to study any problem in the context of a wide variety of situations.

The grants now being made in the area of education, training, learning, and media research tend to be oriented much more to specific problems and problems at specific levels in the schools. The new centers, by taking a broader view of the problem area, will be able to define an interrelated series of problems, and might even be able to provide suggestions which would assist individuals conducting their own projects to relate them to the major thrust of one or more centers with a resulting gain for the composite effort.

Scope of Research Programs

Although one might in advance indicate some of the problems that could advantageously be investigated by the permanent learning research centers, it also seems likely that these centers should, in the course of time, themselves determine what are the most significant problems. This might be their most important first contributions. It seems quite possible that one of our difficulties in the study of learning is that we have not asked the right questions or that the questions which we have asked may be entirely too specific or entirely too general. Out of the welter of work that has already been done, the following would strike me as significant problems to be re-examined, with the possibility that, from them, would come clues to defining new problems or new approaches to dealing more effectively with some of these old problems. The areas or problems include the following.

1. How can we motivate students?

   Opinions of teachers differ as to the extent of their responsibility for motivation, and we lack any definitive set of suggestions which can be given to a teacher to help in the motivation of students. This is particularly a problem at the college level where the majority of the professors continue to operate as though the student would not be in the class unless he was highly motivated to learn what is developed there.

2. What are the effects of teacher and student personality on learning?

Pace, Stern, and a host of others have carried on studies on the relationship of teacher and student personality. These studies need to be expanded at various levels, and more careful consideration needs to be given as principles emerge from such studies as to what legitimate applications of these may be made in planning educational programs. For example, we have resistance to sectioning students on the basis of intelligence test scores, and it may be predicted that even greater resistance would be manifested toward sectioning students on the basis of personality types.

3. What kinds of learning proceed best in group situations and what kinds are best in individual situations?

Although individuals differ greatly in whether they profit most from working alone or with others in mastering new material, it seems probable that certain kinds of learning will be found to proceed best in group situations and others best in individual situations. This may be true with parts of a single course or it may be true with regard to different types of subject matter. It seems, for example, that mathematics lends itself better to learning on an individual basis, whereas some of the social sciences are perhaps best grasped in a group discussion situation.

4. What are the impacts of the grading-course-credit system, which is so important in our educational system, on the learning process?

Emphasis on grades tends to get in the way of student application to the broader objectives of education and frequently the objectives graded direct the students' attention to some of the least significant aspects of education. Furthermore, the course-credit system tends to break the education up into small pieces, and we have found no device to tie these together effectively.

5. To what extent is a discernible press present in various institutions and what is the impact of this press on the learning environment?

The studies of Pace, McConnell, and others, which tend to show that particular institutions have an identifiable character, need to be studied in greater detail, and a special concern is found in a large university where many sub-cultures exist and, seemingly, it is possible for students to identify with an appropriate one and thereby evade the impact of change which might otherwise occur. It is of interest also to know how the particular press of an institution develops and what means might be used to make major changes in it.

6. What are the relationships between some of the principles involved in a logical organization of subject matter and those involved in the psychological aspects of the learning process?

At more advanced levels of education the tendency is to organize subject matter either in the chronological order in which it was developed or on the basis of logical considerations intrinsic to the subject matter itself. Some of the curriculum studies in mathematics, physics, and biological sciences suggest that the distinction between psychological order for learning purposes and logical organization intrinsic to the subject matter may be far less than has usually been thought to be the case. Perhaps in many cases careful analysis would show that the two reasonably well coincide.

7. Do the so-called factors isolated by factor-analytic psychologists have any relevance to the learning process or is the individual so adaptable in the way in which he may learn a particular thing that no such factors are really relevant?

It does not appear that the factors which factor-analytic psychologists have defined have very much relationship to the way in which learning is planned and very little relationship to the kinds of objectives that teachers state. More study needs to be directed to determination of whether the factors which the psychologists find are artifacts of the kind of culture and educational experiences which we provide or whether they really are something innate. If the latter, then it would seem to be worthwhile to study whether educational programs might be replanned in the light of the knowledge of such factors as have been generally agreed upon. A related problem is the apparent shift from a rather broad general factor which seems to be characteristic of younger ages to a rather large number of well nigh independent factors as the youth matures.

8. Does the shift from the general education-single teacher approach of the elementary school to the specialist-multiple teacher approach of the high school and college correspond to an actual change in mental organization or is it only a result of the amount of knowledge and the way we have organized it?

This question is related to the previous one. Despite all the theorizing about how to organize schools, there is no definitive research as to how different patterns of school organization actually affect the learning in which students engage. If there are changes in the mental organization of individuals along with physical maturation, then knowledge of these should enable us to do a better job of planning the nature and sequence of educational experiences.

The question of whether the centers should work at various levels or whether different centers should specialize in different levels is one not easily answered without having more experience than is presently available. Clearly, some students of superior ability have been able to move through the several levels of education very rapidly and have seemed to have found no disabling difference in the nature or organization of the learning experiences. This would suggest that some work should be done in looking at the total educational program; perhaps in attempting to identify major concepts and ideas which would lead to a more adequate tying together of the total educational experience than we now have. It might even be possible to eliminate a number of phases or years in the educational program by more efficient organization. On the other hand, there is evidence to indicate that children at different ages have somewhat different ways of thinking and somewhat different problems. Conceivably, the answer would be, if several regional centers are organized, to have at least one look at the totality of levels of education and others look at different levels of education. By exchange among them, the all-level program might provide the coordinating link for the others.

As to the question of what should be the proportionate emphasis on the basic to applied continuum of research on complex learning, I lean somewhat toward the basic aspect because, as has already been suggested, it seems that much of the research which has already been done has been applied in nature and, hence, somewhat bound to the particular type of education program which happens to exist. Whether experimental schools should be attached to these centers, whether neurophysiological research and other elements should be included should, I think, be determined over time rather than in advance. Conceivably, a program would be mapped out, after a period of years, which would require a group of students in an experimental school program to be at hand for continuing observation over a span of time. On the other hand, such principles of learning as may be applicable to the school situation are not likely to permit the kind of facilities or the expenses which a center might find it possible to have in an experimental program. In short, whatever may be needed in such a center for adequate study of learning should be provided, but the staff of the center would be well advised to maintain some relationship with the reality of the learning process as it is carried on in schools.

If several centers were to be established, it probably would be desirable to delineate the kinds of problems that each would attack. There are, however, so many ways of breaking down the problems of learning that it is a little difficult to even guess what would be the most promising approach. Some of the remarks earlier have raised the question as to whether the process of learning is essentially the same in the various subject matter fields. Is learning of complex psychomotor skills and the learning of cognitive material essentially the same? How does learning in the affective realm proceed? The matter of levels of education is another possible way to assign responsibilities. Still another possibility would be to plan one center around one particular theory of learning and another around still a different theory. In making such differentiation among centers, the advantages of differentiation in terms of covering a range of problems should be weighed against the necessity for some overlapping in study in order that the activities of the several research centers might be additive in nature.

Facilities and Instrumentation

As to facilities and instrumentation, I would make only one statement with reasonable assurance; that is, no matter how careful the initial planning for facilities, they will soon be found to be inadequate. The reasons for so thinking are several: (1) the knowledge which we presently have in this area is inadequate to make decisions as to just what kind of space and instrumentation is needed; (2) the advances in the field of instrumentation are such that within a limited period of months after a particular plan has been put into operation additional instrumentation will be needed to bring the facility up to date. One factor not to be overlooked is that the environment itself has a considerable impact on the learning process and, hence, at least one section of any building that might be made available should be planned in such a way that it could very easily be shifted from one pattern to another. Such things as lighting, furnishings, ventilation, air conditioning, noise level, and many other factors would be relevant for study.

Whether existing buildings or new buildings are necessary to supply what is needed is hardly an answerable question. In these days of pressures upon schools it is not likely that any adequate existing facilities are readily available in the particular locality that might be decided upon for a learning research center. The best idea would seem to be to consider a number of different alternatives with facility and instrumentation planning and, if several regional centers are being planned, to attempt to have each one represent a somewhat different set of hypotheses with regard to the kind of facilities appropriate. Certainly every attempt should be made to include every relevant type of instrumentation now available for the study of learning and for the facilitation of learning. It would, however, be expected that such a center would have a staff of technicians or engineers available and that many adaptations could be made by these persons. Indeed, it is very likely that much of the instrumentation would need to be built as hypotheses were developed and studies begun.

Perhaps, therefore, it would be more important in planning this center to, so to speak, plan the skeleton and let the staff put the flesh and muscle on this as needed for continuing research. In view of the many and complex facilities and instruments needed, one may raise the question as to whether a single, national center might be superior to several regional centers. Moreover, the use of computer facilities and of a data analysis section might well be a common factor for all centers. Of course, it would be very possible to work out a relationship whereby a central facility would handle much of this, even though the centers themselves were spread around the country.

Staffing, Organization, and Administration

The staff of any particular center would certainly depend upon the type of problems which that center undertook to study. If, for example, it was committed by its own decision or by some overall plan to the study of learning problems in the area of science, then very definitely a number of persons representing the several scientific disciplines would need to be available on the staff. In general, any center would have to have persons representing several fields of psychology, sociology, and education. In addition, the biological sciences, possibly including one or more medical research people, would be appropriate and, if instrumentation should play the role that might be expected in this era, the physical scientists would need to be strongly represented, even though the problems studied were not especially restricted to the science area.

I would hesitate to name individuals who should be considered for appointment in such centers. It is my experience that sometimes the names that come most readily to mind as people outstanding in particular areas are not the ones appropriate to consider when setting up a research team which is to work together over a long period of time and in which cooperation among a number of individuals is more important in many respects than the outstanding competencies of single individuals. Assuming that the initial activities of such a center may be very much in the direction of defining problems, and that the most productive research may not come for a number of years, it seems highly important to find a number of able, young individuals for the staff of such centers rather than the outstanding names. This would not rule out the appointment of the latter group, either as permanent staff members or as consultants. I would insist, however, that the learning research center idea is the beginning of a new era and much of its long-term significance will depend upon the in-service training which groups of individuals derive from working in such a center.

On specific questions as to what size of staff would be a minimum for launching such a center and as to whether the numbers of people and types of people would be available, only shrewd guesses can be made. There is little point in establishing a center if one were to think only of bringing together three, four, or even a half dozen individuals. There are many places around the country--in colleges, universities, and even elsewhere--where that many individuals are already associated in research activity. Furthermore, there is very little gain in establishing research centers unless a wide array of interrelated problems can be investigated simultaneously. Finally, we have already noted that such a center would have to have competent people in a number of the major disciplines, including some which have no special competency in learning per se but would have special competencies in the designing of equipment and research studies involving the learning process. All of this leads to the conviction that it would be hardly worthwhile to establish regional research centers with less than 25 professional individuals on the staff. In the initial venture I would suggest that people be given temporary appointments of three or four years on the staff of such a center and that, in the course of time, individuals would then be found who were especially productive in this kind of situation. They should be retained; others should be allowed to return to the more standard types of teaching and research activities. If these centers were established near or on the campuses of large universities, it would be possible to work out relationships where advanced doctoral or post-doctoral candidates would spend some time working in such centers, thus providing a continuing flow of individuals from whom might be selected ones to remain in the centers. The ease with which such centers could have access to consultation, to library, and to graduate students would suggest the very real advantage of locating them on a university campus. No doubt this would greatly enhance the possibility of attracting people to the center because the environment in itself would be attractive to them. Clearly, from what has been said, these centers should be interdisciplinary and, from time to time, the services of representatives of disciplines beyond those regularly provided in the center would be enhanced by the university location.

It should be possible in such centers to work out arrangements whereby individuals whose work in learning is attracting attention could be invited into the center for a period of time, either to continue their research or to provide additional assistance on some of the related research problems already under way in the center. If a center also were budgeted with sums beyond that regularly committed to research in the center, there would be no reason why grants might not be made directly from the center to individuals on college and university faculties engaged in related research or willing to become engaged in related research. It seems clear that such centers should be administered by a director, but it seems equally clear that a high degree of autonomy should be extended to individuals and research teams in planning their activity. In short, the director should be one who is himself involved in research and has a broad overview of all that is going on and a high degree of integrative facility in maintaining for himself and his total staff a unified picture of what the program is doing. There will, of course, in such a center, be innumerable details of financial and business nature which such a director may not care to handle. This suggests that an administrative assistant of high caliber and authorized to act for the director in many of the business and financial aspects of the institution would be necessary. It might be advisable, although about this I am not certain, for each center to have an advisory board of outstanding scholars and educators who are not involved in the center operations. Such a group might provide the medium for interpretation to government and foundations that might be asked to support the center; they might provide also some protection to the center against public reactions to certain types of studies or reports from the center, and they might, finally, be helpful in formulating broad policies for the operation of the center. Should there be several centers, the coordination of all of these might present a problem. The most practicable pattern, as it seems to me, would be to designate one center as the national center, with its director superior to the directors of all other centers which would then become arms or extensions of this main one. The national director plus the regional center directors would then form a planning group to coordinate the activities. The alternative of an individual outside of all the centers serving as director runs the risk, it seems to me, of interfering with the research programs by injecting an individual into the picture who would be, by the nature of his job, an administrator rather than a research director.

Location of Centers

Some of the more obvious criteria which have in the past been used in selecting locations for industries or schools may be of little significance in connection with the learning research center. It is not expected that these centers would be visited by large numbers of individuals nor that they would be involved in a large amount of demonstration activity. Indeed, such activity would be antithetical to the pursuit of the research ideal. Hence, geographical spread of the centers might be a matter of little moment. Likewise, ease of access to the center by the traveler would perhaps be less significant than it would be for certain other types of enterprises. The major criteria, really, would hinge upon finding institutions with a wide range of personnel and resources which would enhance the activities of the research center. The location of the centers, also, would depend upon the number of centers to be established. It seems entirely likely that the financing of these centers will be a problem upon which progress will be made, in part, as the centers demonstrate their worth. It would therefore be better initially to build only one or two such centers and then to expand as necessary. Furthermore, this would enable the later centers to benefit by the experiences and the mistakes of the earlier ones.

I would suggest that two centers be contemplated as the first stage and that these be planned with as different patterns in mind as possible with, in each case, of course, an attempt to maintain some overall hypothesis or theory as to what would be the appropriate organization. With two centers established on these different plans, it should be possible, by study of them for a period of two or three years, to determine whether a number of further alternate plans should be experimented with, or whether one of the original plans is better. It should also be possible to export staff from the original two to build up other centers as they may be identified and developed. With only two such centers established initially and, considering the breadth of our country, it seems likey that one should be established somewhere to the east of the Mississippi River and the other someplace in the far west. If it would be possible to launch two of these in 1962 or '63, it should be then possible by '65 or '66 to begin to develop out of experiences with the first two some ideas as to what the steps should be.

Financing of Centers

It seems to me that the individual operating centers should be completely financed; that is to say that neither the director nor the personnel under him should have to devote any time to raising money. It is difficult to get the concentration that is desirable on research when the continual need for raising funds is being faced, and it is also difficult to get the kind of personnel that one would like to have when less than fairly complete security can be guaranteed to these individuals. Of course, in time, it might be expected, as centers become established, that particular projects would become the basis for special grants from interested groups, and there certainly would be no reason for ruling out this possibility. However, in setting up these centers in the first place, it would seem wise to seek support from such places as the U. S. Office of Education, the National Science Foundation, the several major foundations active in the educational field and, also, some of the major businesses and industries which have developed a pattern of some giving to educational causes. There appears to be a real advantage in developing 15 or 20 such sources for grants in that, in any one year, should any one of them find a reason to withdraw, the total impact on the research center or centers would be far less than if only a single factor were involved. Conceivably, the initial investment involving building and equipment might have to be made by several of the larger foundations, with some commitment for continuing support for a period of several years thereafter. Other organizations might make a continuing commitment, with the possibility that, since this might take some re-alignment of their program of gifts, this could be increased on some regular basis over a period of years. The work of such programs seems so great that it ought to be possible to interest some of the leaders in this country from many different fields of endeavor and, with that sort of backing, the various groups indicated earlier certainly could be prevailed upon to support the program. It might be that the initial request should specify some period of years for support but certainly there should be no implication that this type of endeavor would ever reach a termination point or that it could ever be self-supporting. The one major possibility for long-term support would be that if such units demonstrated their worth the state and federal governments might see their way clear to provide continuing support.

Summary Statements

Despite all of the technological advances which society has made, teaching is still conducted pretty much in the traditional fashion which was evident centuries ago. Our attempts to educate teachers with regard to principles of learning have not been successful because we have not had an adequate understanding of the nature of human learning. At this point in time we are on the fringe (by virtue of the development of teaching machines, audio-visual aids, television, and other related technological items, such as computers) of a complete redefinition of the nature of the teaching-learning process. It is vitally important that these newer media be properly fitted into the educational program in relationship to the knowledge of some fundamental principles. It is essential also that we do not simply displace the teacher, who will remain a central feature of the educational program, but whose role must somehow be redefined as a planner and coordinator of learning activity rather than as a presenter of factual material. It is essential to the future of our civilization that the increasingly large numbers of individuals seeking higher education be accommodated. And it is equally essential that we find new, better, and more economical ways of carrying on education. The amount and the difficulty of knowledge which young people must amass is continually increasing. The necessity of freeing our scholars for more research activity to further expand this knowledge is pressing. Our time-honored procedures are not only too expensive in manpower but they also provide too little opportunity for the individual student to develop at his own pace and to become acquainted with the really significant thinkers and problems of the present day. Increasingly, the focus must be learning and, to make it so, we must know far more about learning than we now do.

REGIONAL LEARNING RESEARCH CENTERS

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Justification: Substantive Comments

In the recent publication *Goals for Americans*[1], the chapter entitled "A Great Age for Science," written by Dr. Warren Weaver, lists the "broad and major goals" which the nation must strive to achieve if it is to reach a state of excellence which will allow it to compete successfully in the world of today. As the first and most important goal, Dr. Weaver lists "Human Resources." In so doing he states:

> "This topic is put in the top position, for *people*, individual *human beings*, are of first importance. If we could interest the right *persons*, and give them the right education and opportunities to utilize their capacities fully, then all other goals would take care of themselves."

Dr. Weaver goes on to say that within our national supply of talent, it is essential that every young person of intellectual promise be given an opportunity to develop to the full; that all students be appropriately exposed to the interest, importance, beauty and excitement of learning.

That our nation is not achieving this goal is evident from a variety of sources. Most telling is the evidence from extensive studies of our educational system at the high school level (by Conant) and at the University level (by the NSF) which estimate consistently that we are giving higher education in our country to just about half of the young people who could profit from it. Obviously something is lacking in our system which either does not motivate our young talent to aspire to the highest levels of learning or which drives them away from it while they are being exposed to learning at lower levels.

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[1] *Goals for Americans*, Prentice-Hall, Inc., Englewoods Cliffs, New Jersey, 1960, Chapter 4.

If we are to concern ourselves with this general problem (and if we are to survive as a nation in the competition facing us, we must) several approaches are possible. Indeed, some aspects of the problem are under intensive investigation already by a number of competent people. Various studies are being made regarding the need for more school facilities; for new and enriched curricula, particularly in science areas; for enhanced teachers salaries; and so forth. In all of this activity one aspect of the problem, the learning process itself, is not being intensively studied. This is especially true when one considers the learning process at the human level, wherein learning is of primary concern to parents, to those concerned with the educational system, to those who are hiring skilled technical workers, and to those interested in the problems of continued learning among our senior citizens.

It is an interesting and paradoxical feature of the pragmatic culture of the United States, that those individuals whose scientific interests are centered around the technical area of "learning" have in large measure assiduously avoided tackling human learning problems in settings that are relevant either to everyday learning in a social setting, or to learning as a process confronting the student, at any level. Historically, American educators interested in the psychology of learning, and American psychologists interested in the problems of education, oriented their research toward increasing the "efficiency" of formal education. With an increased concern in educational circles with the pervasiveness of factors influencing learning, research on human learning came to be viewed as being of such complexity, that it was unmanageable with any degree of precision. Hence, one alternative open to the scientific study of learning was retreat to lower phylogenetic levels. This procedure allowed better control of learning behavior, in laboratory animals such as rats, cats, pigeons, monkeys and chimpanzees--even though the data derived from such research had little, if any, bearing upon the human learning process. Another alternative, that of reducing the human learning process to a minimally complex and manageable level, was chosen by some psychologists, among whom are those using "nonsense syllables" and "memory drums" or various simplified psycho-motor tasks to study learning. Here again, the data bear little upon problems of complex human learning, although the data from psychomotor laboratories have contributed to selection and classification procedures within the military and within industry.

The present state of research in human learning, although widely supported, is, compared to the state of scientific development in modern physics and modern biology, primitive and unsystematic. In fact, learning as a variable pervades almost all areas of experimentaion in the general field of psychology, and is to be found discussed under such headings as: "the developing child", "individual differences", "personality development", "concept formation", "thinking", "problem solving", etc. In the more formal educational setting, studies of human learning are integral parts of routine practical service studies, curricular studies, methods studies, etc. The confused state of research in the general area is perhaps the aftermath of earlier held hopes that problems of human learning, particularly in the formal setting of school learning, would yield to simple studies and theories. This hope having been shattered, the research effort seems to have proliferated in innumerable directions, almost vitiating the possibility of integrative programs of research.

In a substantive sense, there is no better justification for the creation of research centers, than the obvious need to apply a brake to the proliferation in research problems of an individual, miniscule nature, which individually contribute little to a coherent, systematic approach to research on the human learning process. This is not to say that the individual scientist should not be allowed, indeed encouraged, to pursue his problem in any way he best sees fit. It is to say that research programs can be oriented around central issues within the general area of human learning, that individuals who are interested in a given issue can be brought into closer communication with each other, and that in so doing, more effective effort may be brought to bear upon the major problem areas in a way which will enhance the probability of their solution. The pattern is essentially that of the "research institute", a concept which is lacking in most areas of behavioral science and certainly in the area of human learning.

Justification: A National Responsibility

Although not specifically mentioned as such, it is precisely such an area as research in human learning that the President's Science Advisory Committee had implicitly in mind when, in the "Seaborg Report",[1] the Committee described the government's responsibility for "developing" new or neglected areas of science. After pointing out that grants and contracts to individual scientists are most useful in supporting specific research projects, especially when such support is provided with a minimum of red-tape and with relatively long time schedules, the report goes on to point out that project support, in and of itself, does not fully meet the needs:

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[1] Scientific Progress, The Universities, and The Federal Government, Statement by the President's Science Advisory Committee, The White House, Washington, D. C., November 15, 1960, p. 8-9.

> "We can understand this matter better if we consider for a moment the Federal Government's larger purposes in relation to basic research and graduate education. In addition to the research interests of particular agencies, the government has two other more general responsibilities. One is its concern for the development of fields of basic and applied science which may be of general importance for the national security and the general welfare; the other is its concern for the strength of American science and higher education as a whole.
>
> "There are many fields of science in which the United States could well become stronger and more active, both from the point of view of the national defense and from that of the public welfare. It is unfortunately not true that scientists always and automatically sort themselves out into the most relevant and productive fields of work. Science like any other human activity is subject to the distortion of human frailty, and scientific fashion is not always sound. Moreover, even when individual scientists spot promising untilled fields (and it is scientists who do spot them) it is often hard to find funds and facilities for the new undertaking from within hard-pressed universities.
>
> "We think it plain that the Federal Government should act in such areas of scientific promise. No other agency in our society is responsible for the national security, and a large field, full of new problems, such as space science or materials research. is potentially vital to our safety. No other agency in our socity is responsible for the general welfare, and all major fields without exception can be expected to contribute to the general welfare. No other agency, finally, has the financial strength to provide the necessary support--and incentive--for work in expensive new undertakings. It can be said without qualification that our society

> will be indangered and impoverished if these things are not done, and that only the Federal Government can take the leadership to get them done. We do not mean, again, that only Federal action will be needed; we do mean that it must play a large initiating and sustaining role."

Thus, in a substantive sense, the establishment of research centers would enhance sustained systematic work on the central issues confronting us in understanding the learning process. This is in contrast to scattered, individualistic attacks on smaller parts of the major issues. Specific examples of several "problem areas" and examples of "research centers" which have made significant contributions to related areas of science as a result of concerted efforts are outlined below. In the broader sense of national responsibility, we see that the general field of human learning is one which aptly fits the need for development of neglected areas of science as described by the President's Science Advisory Committee.

Scope of Research Center Programs

Inasmuch as the term "center" is widely used to denote a variety of types of activities, it might be useful to point out (or to have members of Committees visit) examples of successful research centers in fields closely related to the area of human learning. One that immediately comes to mind is the Neurological Institute at McGill University. Here, bio-medical scientists have made unusually successful attacks upon a wide range of neurological problems through the cooperative efforts of individuals whose training covers several fields, including: clinical neurology, neurophysiology, neuroanatomy, psychology, surgery, etc. Another is the Worcester Foundation for Experimental Biology, wherein problems of biochemical endocrinology are approached from a number of scientific viewpoints ranging from clinical medicine to molecular biology. The National Institutes of Health illustrate the point of a multi-discipline approach to complex problems. In the study of schizophrenia at the National Institute of Mental Health one finds biochemists, neuroanatomists, neurophysiologists, pharmacologists, psychologists, sociologists, --all working toward a common scientific goal, each bringing to bear upon the problem his own special viewpoint and skill. In this fashion, and only in this fashion, can the many-sided complexities of human behavior functioning both normally and abnormally be unravelled.

Examples of Significant Problem Areas Susceptible of Investigation in Research Centers

1. Definition and measurement of basic human abilities --Probably as significant a contribution as has yet been made to our understanding of human learning is that stemming from the work of Binet in France, and from later developments in the U. S. under the direction of Terman and his co-workers at Stanford. The general description of intelligence, its measurement via IQ-type tests, and the ramifications of this discovery as it has influenced educational practices marks a major contribution to the management of human learning in formal settings.

While we have progressed reasonably far in understanding simpler psychological abilities and their relationship to learning, we are currently but scratching the surface in defining, measuring, and putting into usable form, knowledge of the "higher" mental abilities involved in problem-solving, concept formation, judgmental functioning, executive action, etc. Even less is known regarding the more-subtle motivational characteristics of behavior which contribute to the "drive" of the learner. In this most complex area of ability measurement, the concepts are ill-defined, the techniques for scaling are primitive, and the instruments in existence are quite unsatisfactory for general use. Consequently, the prediction of learning ability is based on the more-static intellectual skills, leaving the effect of the more dynamic factors involved in the learning process almost completely to guesswork.

If one could harness in a research center the pooled abilities of skilled psychometricians, those interested in and having a knowledge of personality psychodynamics, those skilled in the training of children, and those proficient at integrating the work of this diverse group, some progress might be made in this difficult area. In addition, continued research should be done on the stability and viability of already well-defined abilities and their course of deterioration with increasing age. As the population increases in average age and as learning becomes of more importance in the older age groups, it will be important to know what happens to basic intellectual abilities with age, which ones suffer deterioration, and at what rate.

2. The development of learning ability--with emphasis upon the intellectually gifted-- In recent years, especially stemming from the work of Piaget, we have learned much about the development of thought, language and judgment in children. Such concepts form the basis of the most complex type of behavior which characterizes the human learner, and are of the greatest importance to the eventual solution of problems relating to

abstract thought. In a sense, this approach to the subject of human learning is the antithesis of the approach based upon "intelligence testing." Much of the importance of this approach to research on human learning rests upon the fact that it is "clinical" in character rather than "psychometric," thus tapping the intuitive and "fluid" thought processes which are common to creative functions. Perhaps the most important conclusion stemming directly from the work in Piaget's institute has to do with the primitive logical notions upon which the developing child later bases complex mathematical concepts.

The implications of this research are striking and proliferate in several directions. First of all, the simple fact that children develop and handle such concepts at the early age that Piaget has demonstrated indicates the possibility of training children at much earlier ages than has heretofore been imagined. Secondly, the notion that the intellectually gifted child might be discovered early by such techniques also has implications beyond any current attempts to discover genius at a time when the most might be made of it. Lastly, such research in itself is an approach to understanding the process of abstract thinking and how it might be nurtured and modified.

As has been the case to date, this type of research succeeds best when it combines the interests and abilities of psychologists, logicians, mathematicians and children. The approach is just beginning to be exploited in this country and we may hope that more and better behavioral scientists get interested in it.

3. The physiological bases of learning -- Although somewhat biological in orientation, the problems of the neurological and biochemical bases of behavior are sufficiently close to human learning in the pragmatic sense, that this type of work should be included in any program to establish a number of research centers. We are currently witnessing some progress in understanding the neurological basis of "memory," for example in the work of the McGill Neurological Institute. Other important work is promising breakthroughs in our understanding of mental deficiencies, particularly aphasias, which inhibit learning. We are likewise making progress in understanding the training of cerebral palsy cases.

In a less bio-medical sense, it would be profitable to relate neurological research to the "readiness" concept, to yield a better definition of the validity of "readiness" concepts, in a physiological sense. The trainability or educability of a child in certain activities presumably relates to a state of "readiness," i. e. " reading readiness." The efficiency with which the child learns presumably is related to some measurable function, either physiological or psychological. Thus, much might be gained in the determination of what should be presented to the early learner at given developmental periods, through the joint research efforts of the neurologist, the pediatrician, the psychologist and the educator. It is entirely possible that the curriculum of the pre-school could be modified on the basis of developmental concepts, neurological in nature, toward the end of more efficient learning.

4. Learning as a function of environmental factors -- Among several research workers interested in the problem of human learning and the abilities which underly learning, the problem of the influence of environmental factors has been the subject of investigation for several years. This research has in the past taken the form of studies of the influence of environmental factors, particularly the influence of intellectually poor environments upon the I. Q.'s of children. The controversy between the Chicago group and the Stanford group regarding the stability of the I. Q. is a case in point.

In the more recent past, interest has swung to the influence of culturally underprivileged environments upon learning per se, especially in the school performance of children reared in low socio-economic homes, and from racially segregated groups. The need for information on this type of problem occurred at the time integration practices were put into effect. In a more general and cross-cultural setting, attempts to establish educational systems in so-called "underdeveloped" countries also requires greater understanding of the role of environmental influences in establishing the "apperceptive mass" in individuals, particularly younger individuals. The setting of such research ought to be in urban universities, where populations of subjects are readily available. Regional aspects of the problem also could be taken into consideration, wherein there would be revival of earlier studies of the influence of isolated cultures on abilities and on learning. Information to be gained from such studies, on a national base, would be most useful with reference to setting national standards. An analogous contribution on an international level is also possible.

5. Media research -- At the present time there is a plethora of research regarding the use of various media in classroom teaching. I have reference particularly to TV classes and to the use of numerous forms of the Skinner teaching machine. The utility of both of these techniques in improved classroon learning has been amply demonstrated and yet there is a great deal of confusion both at the research level and at the development and application level regarding the use of either TV or teaching machines as

techniques for formal and informal learning. Unquestionably there is a strong cultural lag because of the emotional reaction to the introduction of any "mechanical" device which might interfere in the so-called "teacher-student" relationship. Nevertheless, sufficient progress has been made to warrant an all-out effort to further research and to further the demonstration of new media for the enhancement of learning. With reasoning somewhat analogous to that which was used in establishing the Educational Testing Service as an agency which could be relied upon by educational institutions in solving their testing problems, I would suggest that one Center be established to do research and to do demonstration work on various new learning media. It should be large enough and sufficiently well staffed to be looked upon as a truly "National Center." Its program should be of such a nature that it would be involved in research, demonstration, consultation and service in the sense of establishing programs for the use of media at any institution which might call upon the Center. In a sense, this might be thought of as an arm of the U. S. Office of Education much in the same sense that regional laboratories are arms of the Agricultural Research Service or as regional laboratories are arms of the Public Health Service.

Organization and Management Concepts

There are innumerable specific details relating to equipment, staffing, financing, etc., that will require solution for each of any given number of research centers. Many of these detailed questions are so inextricably bound up with local contingencies that no attempt should be made to specify the particular conditions that will obtain with reference to a given research center. However, there are several general principles regarding organization and management that should be followed.

1. Relation to Universities -- It should be recognized as a fundamental principle that research centers devoted to the study of human learning are best associated with universities. Among the advantages to be gained from such association are: the active participation of outstanding scientists already in the university structure; sponsorship by universities will enable such centers to further attract on either a short-or long-term basis additional competent workers; the standards of the university will ensure the maintenance of high standards in the center. In addition, the presence of graduate students in the university will allow the benefit of training which is present in the work of the center to seep into both pre- and post-doctoral work in the departments. In many instances, major

equipment needs such as computers or closed TV systems will be a part of the university, thus enabling the center to take advantage (while paying its fair share of the costs) of existing facilities. In a similar fashion, research requiring the presence of formal school set-ups ranging from pre-school to graduate levels can be found in university communities. Last, but not least, the members of research center "teams" will benefit from the interaction of the many intellectually stimulating features of a university community.

In this basic principle, we again are in agreement with the President's Science Advisory Committee when they state:

> "The central proposition of this report is that science and the making of scientists go best together. This means that when it can be managed, basic research should be done in, or at least in association with, universities."[1]

2. Staffing, Organization and Administration -- Working from the fundamental principle of close association with universities, research centers should be conceived of as appendages to the university, with professional personnel having appointments in appropriate departments. In general, centers should be thought of as agencies for the conduct of inter-disciplinary research, and not as agencies to perform the educational functions of recruitment of students, teaching, and degree-granting which should be retained by the established departments or divisions of the university. For example, doctoral theses and post-doctoral research might well be conducted in a center, but the sponsorship of the candidate and the accompanying educational functions remain a part of the university *per se*. However, by the technique of joint appointment, staffs of centers retain interests and responsibilities in both center and department, thus avoiding the second-class citizenship problem so prevalent on campuses when there is no appointive relationship between traditional university units (departments, schools, etc.) and the appended institute or center.

The head of the center should be a senior scientist (perhaps on leave from the local or an equally respected institution of higher learning). He must be a person with both research and administrative skills who probably should not want the job on a permanent basis, but who could, if necessary, maintain the position over a period of years. Specific examples that come to mind of successful research centers are: the Psychoacoustic Lab at Harvard, wherein a strong scientific head (Stevens) maintains an independent group within a distinguished departmental setting; the Communications Laboratory at MIT, which brings together under a strong leader with a wide-range of abilities (Rosenblith) a very differentiated collection of talented people; and, (in completely unrelated areas) the Fermi Institute at Chicago, wherein a talented head (Anderson) administers a brilliant group of scientists working on inter-disciplinary problems within the setting of a strong university division; or, lastly, the Computer Center at the University of Illinois which serves as an all-university research center under the direction of an applied mathematician (Taub) with a wide range of interest and talent at his disposal.

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[1] *Ibid.*, p. 20.

Turning to the recruiting problems related to staffing the centers, probably the soundest principle to invoke is to locate the Director, and leave up to him the task of recruiting staff below him. Selecting Directors will in itself be a major task because of the dearth of young full-professor level individuals in psychology today (as witness the number of department headships going begging). The ultimate size of any group is a function of the degree to which the work gets moving and prospers. However, a minimal "mass" probably would be around five people plus supporting clerical staffs and the maximum could grow to as many as fifty professionals plus supporting staff.

3. Location of Centers -- The location of research centers should be in large measure, a function of the location of universities having strong programs in behavioral science. To the extent possible, and taking the first point into consideration, regionality should be a principle to invoke for several reasons, not the least of which is to satisfy national responsibility factors. There probably will be some tendency to group in the northeast, the midwest and the west coast because of the strength of psychology and education in these geographic areas. In my mind, the most important criterion is the presence of able persons who, in turn, will entice more, able people to join them. Under no circumstances do I believe that a center should be located at a second-rate institution with the thought that in so doing the institution will be "strengthened." To do so will more likely drag the center down to the level of the institution.

4. Evolution of Centers -- As to the number of centers and the rapidity with which they are developed, I believe that it would be doing well to try

to establish no more than two or three a year for the next three years, ending up with nine or ten scattered around the country. To take two or three at the most as a beginning will allow the field to absorb the requirement for people, will give those responsible for their establishment the experience of trial and error, and will be financially feasible with appropriations which will possibly be made available.

It probably would be wise to do a nationwide swing through several possible university sites as a preliminary review of potential locations. Then one, or at most two, sites should be selected for the intensive development of the first one or two centers. There will be many unexpected problems during the evolution of a center and before plunging into more than one or two of them, try to find out the organizational and staffing difficulties in developing one or two good centers. (If your experience is anything like mine in attempting to develop marine biology stations, you'll be ready to quit after two!!) Seriously, I would select two different types of centers, at two different geographical locations, and in different types of schools, i. e., private/state, very large/medium, southeast/west coast, for example, to see what kinds of problems turn up.

5. Financing -- Regarding financing, it should be a guiding principle to get long-range financing at the outset. Two models that are not currently popular in the more active research supporting agencies, i. e., NIH, NSF, NASA, should be investigated -- that of the Agriculture Experiment Stations and that of the Child Welfare Stations. With the current interest in general support of higher education it is entirely possible that the Office of Education could work out a pattern based on these two, but using the contract technique of AEC in its National Laboratory program. There are dangers of "over-stability" in the Agriculture Station pattern and too much interference at the local level. However, some technique ought to be possible which would have the advantages of this basic idea, with built=in safeguards against the "settling-in" dangers that are inherent in it.

The NIH pattern and the NSF pattern, which is predominantly short-term (2-5 years) project and program oriented (excepting the Greenbank Radio Astronomy lab type of support) are, in my opinion, in need of revision to meet the needs of "center" support. Even with 7-year annually funded commitments from NIH, I would be wary of accepting a center at any university for which I was responsible. I would also be wary of joint-university associations as recipients of center grants. Despite some popularity of this concept, i. e., Brookhaven, ARMU, etc., I believe such devices, having served a purposes, should be by-passed in favor of single-institution arrangements. Any given institution has enough administrative red-tape without compounding it! I would suggest a thorough review of the Agriculture Station pattern, with the possibility of leaving about 25% of the program of a given station to be financed by grants. This would introduce a sufficient amount of insecurity to keep the staff alive!

As for sources of support, I would depend primarily on government financing. I am not frightened by the thought of interference and the pattern of private foundations of "starting" things and then leaving them to survive is a discouraging one. At any given center I would hope that the total support might be shared on a 75-25 basis between Federal government and other funds, locally derived. As for the government supporting agency--I believe the human learning research centers should be developed under the Office of Education program, to off-set the emphasis on medical and physical sciences research in NIH and NSF, respectively. Also, such research will bridge the gap between science and education, a bridge which is necessary if we are to strengthen both science and education in the U. S.

Miscellaneous Comments

In reviewing the suggested "outline" I find that I have implicitly answered many of the questions, but have not commented directly or indirectly on others. It might be helpful here to cover some of these:

1. Problems inherent in programatic research -- good leadership is scarce; sustained drive on difficult and complex problems is hard to maintain in a group; the individualistic tendencies of scientists (particularly psychologists) will be hard to overcome in recruiting and maintaining a group; project funds are so plentiful that each person, however competent or incompetent, can get them for his own little independent "show."

2. Emphasis -- I believe that implicit in the above is an emphasis on research at lower school levels, excepting the "biologically" oriented center and the media center. The college sophomore has been overdone as a subject of study with little meaningful data coming from him. I believe children have long been overlooked as good research subjects for the study of human learning.

3. Basic/applied emphasis -- Allow nature to take its course, but don't let centers deteriorate into "basic learning,"

rat laboratories, i.e., stick to human learning level, although theoretical "model" building, for example, should be perfectly admissable as an activity. What I have in mind is that regardless of the basic/applied emphasis, sticking to human level problems should be a fundamental principle of operation.

4. Facilities, etc. -- These are largely determined by the director and group, but I would avoid new construction because of the cost and the delay. Access to pre-school subjects is a necessity and access to computers, etc. is also necessary. Access to a wide range of scientific disciplines is also desirable.

5. Criteria for location and financing -- I believe these are covered above.

CONSIDERATIONS INVOLVED IN THE ESTABLISHMENT OF REGIONAL LEARNING RESEARCH CENTERS

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A Rationale

The discussion which follows has been developed from a premise that regional research centers are more desirable and necessary than having one large national center or hundreds of independent research projects scattered around the country with individual scholars and institutions. This position is taken for several reasons:

1. Politically, it is more expedient to develop regional centers rather than a national center. This grows out of the great concern, both within and without the Congress, to be certain that controls are not exercised over education at the national level.

2. It is possible to attack problems of major national concern better through regional centers than would be the case if it were all locally conceived and conducted.

3. It will be possible to rather clearly delineate the responsibilities of the various regional research centers so that they will operate within a structure and framework without stifling individual researchers.

4. Participation in research projects and the acceptance of the results of the experiments will be more readily accepted by the educational institutions if the research is done at a regional level rather than either the local or the national level.

The writer recognizes that references which are made in this paper to the National Aeronautics Space Administration and to the atomic energy programs as examples of achievements of major significance are national programs rather than regional and there is, therefore, a conflict in philosophy. NASA, for example, has been able to achieve major breakthroughs in space explorations because of a concentration of activity at the national level which in turn has been delegated to subunits to be researched--but always under the direction of the national group. It is true that certain of their installations are regional in nature because of climatic reasons, such as the installation at Cape Canaveral.

The point of view of this document is that, because of the peculiar nature of education in the United States, it is desirable to operate through regions for broad scale attacks on problems with the necessary coordination at the national level possible through various kinds of administrative and committee devices.

Introduction

If one takes a look at our early history, the concept of regionalism has always been present. For example, from the very beginning there was an area of the country known as the New England States, another group known as the Middle Atlantic States, and still another known as the Southern States. It is interesting to note, too, that many sections of the country originally were represented by large blocks of land representing to a degree regions which were eventually broken up into states. Such territories as the Louisiana Territory, Oregon Territory, and the Indian Territory exemplify some of the characteristics of what we would now think of as being regional attachments and relationships.

It would appear reasonable to say that so far as education is concerned, historically it has been a state function; and, consequently, there has been a minimum of liaison and cooperation among the states.[1] What formal organizations there have been are primarily national associations linking together institutions with some common background, such as the land-grant colleges and the American Association of Colleges and Universities. More recently, there have been some more formal compacts such as the Southern Regional Education Board, Western Interstate Conference on Higher Education, the New England Association, and the Big Eleven institutions. Most of these groups are primarily concerned with higher education, although the Southern Regional Education Board has conducted some activities at the public school level. The various accrediting groups also have been regional operations which include both public and higher education. One of the most recent attempts to conduct educational activities at a regional level for elementary and secondary education has been the Midwest Program on Television Instruction. In the field of television there are other interconnections under discussion such as the Midwestern Educational Television, Inc.

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[1] See Royce H. Knapp, American Regionalism and Social Education. Harvard University Press, Cambridge 38, Massachusetts. 1947.

The above discussion is intended to show that historically there is precedent for regional developments of one kind or another. The existence of these large varieties of cooperative endeavors indicates that there are some needs which are difficult to meet satisfactorily by the individual states or the institutions within these states.

Justifications for Establishment of Regional Learning Research Centers with a Programmatic Orientation

There is no question but that current programs in the area of educational research are having a profound impact upon educational theory and practice. Much new information is being gained as the result of research being done under governmental, industrial, and foundation contracts and grants.

In spite of the substantial gains in new knowledge resulting from the current programs, there is still not sufficient patterning of the research activities. Very early in the Title Vll program, for example, several attempts were made to bring about a voluntary focusing on and attacking of problems which urgently needed solution. It was evident that there was complete lack of research findings in some areas of learning and instructional procedures. For example, Dr. William Allen very early developed a series of charts showing the lack of research evidence in many areas of media usage. The assumption was made that by calling attention to the voids in research knowledge it would naturally follow that proposals would be developed to deal with those areas. Another attack on the same problem was made possible through funds from Teaching Films Custodians, Inc., which were made available to the Research Committee of the Department of Audiovisual Instruction. The major purpose of this grant was to attempt to secure more complete researching of those areas of media usage in which answers were urgently needed. The staff of Title V11 has released figures periodically which have indicated the concentration of grants to such activities as television, motion pictures, and teaching machines, and which in turn have disclosed the almost complete absence of research projects in other areas. Although the primary purpose was to report the status of the Title VII program, it obviously also was intended to produce research activities in those areas almost untouched. Undoubtedly these activities and others had some impact on funneling research proposals into needed areas. It is evident, however, that the task was not completely accomplished since many of the imbalances still occur among research in media as well as in purposes to be served.

The question might be raised as to why the Federal Government might not assume a greater role in patterning the research activities. Without doubt the various governmental agencies have people with capabilities of assuming such roles in the development of research grants and contracts. The major arguments against it are at least two: First, this kind of activity would, in fact, constitute federal control of the research program because the governmental employees would be making decisions about the activities undertaken. Second, there is the feeling that the researchers and the institutions themselves should be in a position to identify the needed areas including the design of the research studies. To identify people or institutions without their having identified the problems could lead to a waste of energy and money.

In a positive way, the Manhattan project during World War II and the NASA experience in current space explorations are excellent analogies as to what large-scale, problem-oriented research projects can do. In addition to these two dramatic examples there are many others which might be cited of the way in which carefully designed step-by-step research and product development activities have lead to massive breakthroughs in new knowledge as well as in program development.

There are undoubtedly many reasons why these large-scale projects have yielded such worth-while outcomes in terms of basic knowledge and product development. One line of reasoning is that these projects have brought together scholars within a discipline, as well as among the disciplines. The likelihood of this kind of cross-fertilization taking place without large-scale, carefully designed research activities is highly improbable and did not take place in any other sector of our scientific enterprise until large-scale efforts were mounted. It is unlikely that continued major breakthroughs in learning and instructional technology will take place without similar efforts.

There is no question but that the research activities under the cooperative research program of the USOE and the National Defense Education Act have begun to make progress along the lines suggested above. What may have appeared earlier in these programs to be constant rounds of conferences and seminars has proven to be the beginning of communication among individuals within the field of education with, in some cases, contacts being made with some scholars in other disciplines. The striking fact about the many activities supported by the Federal Government has been the development of new theories, hypotheses, and applications which would not have developed if each group of specialists had communicated only among themselves.

Research centers will likey be most productive if the idea has general support by researchers and scholars in the various institutions and from representatives of the various disciplines. Further, successful efforts along these lines have generally called for the development of appropriate advisory bodies which represent all of the administrative and educational interests related to that problem. Further, the various content areas are organized differently among the areas as well as among the several levels of elementary, secondary, and higher education. It is necessary, therefore, to study carefully the various interests which must be represented in such an advisory committee and to make appointments so that these interests feel appropriately and adequately represented. It is obvious that such regional activities as those under consideration here will require cooperation rather than competition among the various institutions and among the various specialists if the effort is to be productive.

It will also be necessary to have close working relationships with the various state departments of education within the area. This unit in public education is often not understood by individuals in colleges and universities, but it is the significant link between the Federal Government and the individual school districts. If experimentation and research are to involve public schools and use public-school student populations, it is mandatory that these departments are aware of the purpose of the centers and in turn are deeply involved in their activities.

Scope of Research Programs

Because the problems of learning and instruction are so similar, extending from the pre-school to the graduate level, it would appear that each center should give attention to the full range of educational activities. It is quite likey that some of the centers will give more attention to certain levels and kinds of activities because of the very nature of the interests and abilities of the staff working in the center, as well as the interests of the educational institutions in which some of the field research might be done. Further, it should be required that members of the staff of the several regional centers meet together periodically to plan and to exchange information, research results, and similar kinds of information. If each center were to specialize on a certain level of educational activity, it would appear that the possibilities of the various staffs stimulating each other would be dimished.

At this stage of educational development, it would seem that considerable attention ought to be given to what one might call "basic" research. It must be recognized, however, that unless some attention is given to product development and laboratory tryouts the practicality of many ideas coming from basic research might never be validated. As Nicholas Fattu of Indiana University recently indicated, in the business world $1 worth of basic research requires $10 of product development and $100 to promote and gain acceptance of the product. A further argument for some attention to product development is the experience in the National Aeronautics Space Administration where the development of hardware is proceeding almost simultaneously with the discovery of basic research findings. Before the various hypotheses have been tested thoroughly research-wise, the hardware is developed to test the hypotheses in a laboratory setting.

A somewhat lengthy discussion of the various categories of research is included as Appendix A.[1] This material comes from the Joint Committee on Auto-Instructional Programs and Devices, of which the writer is one of nine members. What is found in Appendix A is a somewhat modified version of the material which has some application to the emphasis which should be given to various kinds of research conducted by the center.

It would seem that research ought to be conducted and, in fact, encouraged covering the full spectrum of human behavior even though the information gained may not appear to have immediate application to learning and teaching in formal classroom settings. It would be excellent if the basic research might contribute to the solution of practical problems, but this should not be the only criterion used in deciding whether activities should be initiated.

So far as the facilities in which the laboratory research might be done, it would be hoped that it would not be necessary to develop special experimental schools outside of those normally operating in connection with teacher education and other instructional programs. It would be expected that considerable use might be made of regular educational institutions which would be oriented to research activities to the degree that their student populations might be utilized for experimentation.

In regard to the different kinds of activities which might be attacked in the various centers (assuming several would be established), I would feel that each should have an orientation toward the specialized interests of the staff and the needs and demands of the region being served. I believe that it would be inappropriate to impose too rigid restrictions on the various centers. The identification of the centers as to type of research should be kept as flexible and as fluid as possible so that the problems which they attack are those which seem pertinent regardless of the area or the level in which the problem might exist. Further, if one were to limit too greatly the activities of these centers, it might present a problem in the future when their focus should be different because of changing situation.

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[1] Editor's note. Appendix A follows the text of this paper.

Facilities and Instrumentation

The main characteristic of the buildings which would house the regional centers should be that of flexibility. The facilities are likely to be constantly changing so that open space which might be easily subdivided would be the main requirement. Just as most of the industrial plants make permanent construction of just the outside shell of the plant, so this type of arrangement also should best suit the present and future needs of such a center. It would be hoped that during the initial stages of these centers it would not be necessary to build new facilities because the construction would involve substantial expenditures for capital improvements which would lessen the amount of funds which would be available to actual research. This does not mean that old and dilapidated facilities will be satifactory. At best, it would seem that buildings could be leased until the nature and design might be more clearly indicated if it should be decided that new construction would be required.

Just as in the case of the buildings, it would seem desirable to include a minimum of hardware and equipment--at least as a beginning. The center should be in a position to acquire, either on permanent purchase or on rental, certain kinds of technical equipment depending in part upon the research undertaken and the interests of the researchers.

The location of the centers should be such that they are physically located in close proximity to data processing centers, excellent library resources, and other similar kinds of resources. Such a matter as the accessibility to subjects should be taken into account in the location of the center in much the same way that the development of medical colleges has been dependent upon the availability of a wide range of clinical cases. It would seem that the plans of Title VII of the USOE to activate information retrieval centers should become an integral part of the operation of the research centers. This would, in part, dictate that the centers be located in close proximity to national communication systems so that information could be economically and quickly secured at each center. Although close cooperation and liaison should exist among the several centers, it would seem wiser to rely upon data processing centers, library resources, and similar services from one or more institutions adjacent to the center, rather than sharing these among the several centers. I feel that the questions about facilities and instrumentation are in part related to the location of the centers and should be considered in this context rather than under the heading of "Facilities and Instrumentation."

Staffing, Organization, and Administration

A variety of research personnel should be associated with such a center, including such people as psychologists, sociologists, anthropologists, and communications specialists. These individuals should be well grounded in the behavioral sciences and should be highly competent and respected researchers. Some members of the team must have orientation to classroom instruction in order to assure that every effort will be made to apply the basic research findings. Represented in the group should be a wide range of interests and characteristics from people with a disposition toward both purely basic and theoretical activities as well as highly practical and applied ones.

In order to adequately staff such a center, it is likey that at least 25 professional people would be required, along with a considerably larger number of semi-professional, technical, and clerical workers. The numer of people available who are well suited to such an assignment are at a premium. It is possible that some period of training might be required for some of the people who would serve such a center. This is especially true since, as I have suggested, the staff should be interdisciplinary in nature and the supply of individuals in disciplines other than education or psychology who are oriented to instruction and public education are even fewer.

The question as to whether a center should be located in or adjacent to a major university or whether the center should be entirely separate deserves the most careful analysis. I am inclined to support the idea that the center should be located in close proximity to a university. The accessibility to library, computer, and other similar resources, as well as the availability of other scholars from the university for discussion purposes would be a distinct advantage. The whole climate of a major university would contribute to the productivity of the center. The increasing number of cooperative programs involving groups of universities and the scholars within them indicates that inter-university cooperation is possible even though the program involved is based at a specific institution.

It should be recognized, however, that in the case of some of the large research programs in other areas the facilities are completely distinct and, in some cases, at quite a distance from the sponsoring university or universities. Such examples are the atomic energy operations at Los Alamos, New Mexico, and at Livermore, California. Although these installations operate under a contract with one or more universities, it has been felt advisable to separate the facilities and personnel from the university base. One of the intentions is that of securing greater concentration to the problems at hand and to assure a minimum of interference. This type of operation should not be ruled out entirely in the case of the regional research centers for education.

I feel most strongly that the genius of the regional movement is cooperation rather than competition among institutions and scholars. This is a somewhat new concept, especially in higher education where the process has generally been one of promoting the status of one institution and downgrading the reputations of all of its competitors. Regionalism grows out of common respect for and belief in the contributions of all of the scholars and institutions within a region. If the idea is to succeed it is absolutely essential that the location of the centers be on the basis of the support of the majority of concerned individuals and institutions in an area rather than on an arbitrary selection of an institution or by a "bidding" process. It is mandatory that cooperation be developed within the region as well as among the several centers. If this kind of spirit does not prevail, there will be distrust and jealousy which will limit the success of the centers.

Just as each of the regional centers should have an advisory committee, as indicated earlier, there should be a national advisory committee made up at least in part of the administrators and some of the staff of the regional centers. These groups should meet periodically in order to coordinate the immediate and long-range efforts lest the regional centers fall into the same narrowness of orientation which has characterized much of the current research. To this degree the research program is a national one, but decentralized to regions for more effective operation.

Location of Centers

Criteria for selection of the regions might include the following:

1. The total scope of educational institutions should be represented in the region. This is essential in order that there might be at hand the widest possible range of problems for investigation which are being

faced by American education today.

2. The region should have common economic, political, and cultural characteristics which differentiate it from other regions. It is a well know fact that certain parts of the country are oriented toward states' rights, another section of the country may be more concerned with its cultural and historical heritage, and still others will have different underlying philosophies.

3. There should exist within the region potential for research and experimentation. This would mean that the region should be sufficiently large so that it includes diversity of institutional settings, interest on the part of educators in the region for such a facility, and willingness to cooperate in its development and utilization. This is a most important point since there must be mutual concern and interest among the scholars in the area; otherwise, the center is not likely to be productive.

4. There should exist within the area regional compacts or other similar cooperative efforts. As indicated earlier in this paper, many parts of the country are already covered by regional compacts which help to define certain geographical boundaries.

5. There should exist active regional accrediting associations with interest in research and experimentation. Once again, the regional associations very often have boundaries similar to the regional compacts.

6. There should be previous experience in the area in sharing research activities, staff members, and other similar activities among the various institutions and states. Even on a voluntary basis there are many evidences of joint cooperation.

7. The region should have some commonality of communication and transportation systems. Because of the necessity of frequent communication, either face to face or by remote methods, the region should permit quick and easy possibilities.

Criteria for use in determining the centers within regions (presuming they will be located at universities) might include the following:

1. A member of some regional compact.

2. A member of one or more of the regional accrediting groups and one or more of the national prestige associations.

3. Demonstrated leadership in and experience with a wide variety of research programs.

4. A desire to house such a center, including a willingness to make available certain facilities and services.

5. Support of the institution by other institutions, state departments of education, and scholars.

6. A wide variety of superior resources and facilities such as libraries, television station, a computing center, a strong audiovisual center, and print and visual production facilities.

7. Accessibility to a wide variety of student populations for research purposes.

8. History of successful completion of a large number of research undertakings.

9. Good transportation and communication systems within the region.

10. A community of scholars within the institution who have mutual regard and respect for each other.

Examination by a number of people of what constitutes regions of the United States has indicated that the country is made up of no less than four regions and no more than six or seven, probably the latter. The U. S. Government has, for a variety of purposes, organized the country into four regions, but this seems to be too few and does not adequately take into account the peculiar characteristics of the different parts of the country. A more realistic approach seems to consider the following: the New England States; the area covered by the Southern Regional Education Board; a group of states including possibly Maryland, New Jersey, New York, and Pennsylvania; the North Central and Great Plains Region; and the mountain and Pacific states covered by WITCHY.

Again, in connection with other projects, it has appeared best to activate two centers a year, selecting them so that each center and its region represent a different geographical area with somewhat different economic, social, and political problems.

Financing of Centers

On the financing of the centers, I suspect it will take some time to secure adequate funding to do the job. As most programs operate, it will probably be necessary to give financial support at an increasing rate over a period of years until an appropriate level is reached. As a minimum it would seem necessary that they be funded initially at a level of $5,000,000 each, rising in possibly five years to something in the vicinity of $25,000,000 for each. Since funds are likely to be limited the first year or two, this is one of the reasons for indicating that only two centers should be activated in any one year.

The first source of support should be federal funds with as firm commitments as it is possible to obtain for funding over a considerable number of years. In addition to federal funds, major foundations should be encouraged to contribute, particularly in the development of facilities and securing of instrumentation. Also, business should be approached to contribute equipment and hardware which could be tested under experimental as well as normal instructional situations.

Another source of funds may well be from public schools where small amounts of money are now being set aside for research and experimentation. Since the educational institutions will profit enormously from the research findings, systematic attempts should be made to stimulate an increasing flow of financial support from this source.

Summary Statement

The need for such centers grows out of a conviction that vast improvements in education are needed which research will help to supply. The first step is the bringing together of scholars representing the various disciplines who will, if past performance is any criterion, be much more productive and creative as a group than they have been individually. Although all of the basic research and theories were available to develop an atomic bomb, the act did not take place until mathematicians, physicists, and chemists were assembled at the University of Chicago in the early 1940's. There is every reason to believe that similar dramatic breakthroughs will be accomplished if the means are provided to physically bring researchers together for prolonged periods of discussion and activity.

The second need grows out of the desirability for scholars and institutions to be cooperative rather than competitive. This idea has not been highly tested in higher education and will require a somewhat different orientation in order to be successful. The evidence is, however, that there are a sufficient number of activities of a cooperative nature underway which show promise that similar activities could be taken on a much broader scale.

Any researcher who has worked extensively in the field of education is struck by the fact of how little firm research evidence--rather than how much --we have for better instructional practice. There is a need for product and hardware development growing out of research findings rather than the typical approach which is for business to develop a new item and then attempt to find ways of integrating it into the educational system. It is proper that industry should take the lead on selling its products, but the products promoted should have sufficient research justification to warrant their acceptance and use.

It is obvious to even the most casual observer that the great challenge of today's world is an intellectual one. The observable evidence is in terms of hardware and productivity, but lying behind these advances is basic research information and its systematic application to problem situations. Although the educational enterprise is quite successful, there is reason to believe that the surface has not yet been scratched so far as efficiency and effectiveness in learning and teaching are concerned. The country which is able to effect major breakthroughs in this area will, in the long run, be the winner in the world struggle.

APPENDIX A

Both in deciding which categories of research most need support, and in assessing the merits of a particular proposal within a category, this question should be asked: "If the proposed plan is carried through, what can be done usefully with the result or outcome, either immediately or ultimately?" However, the relevant basis for answering this question differs somewhat in the case of "basic research," "development" and "dissemination" (see below concerning usage of these terms).

The outcomes of basic research can be assessed with respect to how likely the technique, principle, instrument, or theory is to be productive as a basis for future development, or for making decisions between alternative future courses of action. On the other hand, the assessment of a product-development project should be based on whether it appears likely that there is a need for such product, whether the result is likely to provide a useful advance over what will otherwise be available, whether it is likely to be applied where needed, etc. Thus the kinds of outcomes to be expected differ for the three broad categories of effort described below.

Research, development, and dissemination. Three major categories of work need to be distinguished: Basic Research, Development, and Dissemination.

Category A--Basic research. This is directed toward the building of a science of instruction or programming. This category includes three sub-categories: (I) "Exploratory" research; (II) Hypothesis Testing; and (III) Studies of new evaluation techniques.

Category B--Applied research and development. This category encompasses: (IV) Program development; (V) Field-suitability tests; (VI) Administrative studies.

Category C--Dissemination. This includes the sub-categories of: (VII) Demonstration studies; and, finally (VIII) Utilization.

Each of these categories is separately described below, along with criteria for evaluating proposal within each category and considerations relevant to amount of support desirable for the category. A summary outline is provided in Table I. It should be recognized that there are necessarily "gray areas" between categories, and that in some cases a single proposal may well be aimed at several phases of work, each of which falls into a different category.

Category A--Basic research

I. Exploratory research

This is a highly important and insufficiently supported type of research. It is research carried on by investigators indulging in their curiosity about nature. It is generally aimed toward establishing the existence of some phenomenon and discovery of the conditions under which the phenomenon occurs. Such research often attempts to discover new methods and techniques. Good research of this type is carried out with extreme care, careful observation, and sensitivity to all possible influences. Exploratory work would also include such non-data-producing activities as needed critical review of the literature, generation of theory, and other similar activities.

With this type of research the experimenter gets ideas and pursues them to see where they lead. Essentially this is a process of trying out different methods of bringing about particular behaviors. Some ideas may work and others may not, but little attention is given to detailed or elaborate experimental design and procedures whereby different control group comparisons are made. After a number of ideas (potential variables) are identified and translated into experimental operations, they are used either singly or jointly--often in extreme forms--to find out if they make a significant difference in performance, and/or to assess whether the over-all effect resulting from their combined use really makes a clearly discernable difference in learning, retention, or transfer to varied applications.

The support required for hypothesis discovery resulting from either exploratory observations or critical scholarship is "risk support," and agencies cannot expect to rely on the same criteria used in evaluating formal studies designed to test established hypotheses. Rather, a selection must be made of men on the basis of the kinds of ideas they express and the reputation they have for previous creative research. The individuals identified need not always be well established. If bright young newcomers are known to have ideas they too should be supported, provided they are recommended by reliable established men.

In order to encourage diverse approaches, the only mandatory criteria should be that the plan be well stated and logically consistent, and that the effort be a relatively modest one in which the requirements for successful accomplishment are available, e. g., subjects, equipment, technical consultants, and assistance.

II. Hypothesis testing

In this category are those research projects which purport to test a potentially useful statement of a relationship among variables. Those hypotheses which are confirmed will state relationships between independent and dependent variables. The criteria for evaluating proposals in this stage are primarily those of potential value to the field, plus good and efficient research design. Here the proposal must be judged as to adequacy of the formal aspects research design, sampling, measuring instruments, procedural control of extraneous variables, etc. The variables investigated in hypothesis-testing research should be clearly defined (preferably in theoretical rather than gross empirical terms) so as to be potentially capable of generalization. Comparisons of vague global concepts such as "conventional instruction versus teaching machines" clearly do not meet this criterion.

Investigations of promising hypotheses developed by research in Category I should be given preferential consideration for support in this category, as should research which is closely related to theoretical considerations. Good proposals in the hypothesis-testing category, meeting the above stated criteria, should continue to get the high priority support they have received in the past.

III. Development of new evaluation techniques

Research projects in this group are methodologically oriented and deal with measurement requirements. There is strong reason to believe that the traditional approaches to achievement testing are often quite insufficient for recent curriculum developments. There must be developed a more efficient "educometric" methodology. Desperately needed are more adequate criteria for the evaluation of program content, program effectiveness and devices. Worthy proposals in this category deserve high priority, but the total number of such proposals is expected to be small.

Category B--Applied research and development

Development activities can have two distinguishable outcomes. One is simply a usable product of superior quality (a device, film, program, etc.). The other is the creation of communicable know-how. An effort yielding only development of a specific product might merit support, but only if the product will clearly be superior to, or very different from, one which would be commercially profitable. (This might be because the developmental process is too costly or too risky to warrant commercial support or because the potential commercial value would be realized too far in the future.) When a development project would produce communicable know-how, it adds to useful knowledge capable of resulting in other new products of comparable sorts; and, therefore, it should be supported.

While either of these should be encouraged, preference should be given to the simultaneous realization of both goals. The know-how objective cannot ordinarily be reached unless accompanied by production of an adequate product: i. e., the new technique needs to be exemplified by a specific product. However, the reverse is not necessarily true: A high quality product could be created without being accompanied by detailed procedures of general usefulness. Therefore, a project which proposes only to develop a superior product may sometimes be deserving of support, but added basis of support is provided if the project also proposes to yield a good recipe for similar projects. (A good cake may be worth producing even though you do not also come out with the recipe, but you would rather have both cake and recipe.)

IV. Materials development

Some support is needed for the development of new instructional materials, but only in the case of those (probably rare) proposals which unequivocally possess the following characteristics:

(a) Program development should include as an important first step the development of a criterion measuring instrument. This instrument should specify in detail, and in operational terms, the desired educational objectives of the material.

(b) If the only outcome is the material, it should be clear that the material is one which would not be profitable for a private concern to develop.

(c) While material development should justly receive support in its own right, additional worth accrues if there is also developed a communicable specification of the useful new procedure which the product exemplifies.

V. Field suitability tests

This is a "shakedown test" of material developed in Category IV, which often reflects knowledge generated by the first three categories. The field test discovers how the effects of the materials, procedures, or devices are attenuated or modified by complex uncontrolled conditions in the field setting. Good work of this type should attempt to get suggestive information as to causes of any deficiencies in application and of ways to alleviate these when possible. Rough edges and crudities of operation are polished and made explicit; procedures are revised in preparation for dissemination.

This step should be broad scale and long term. A sizeable program--one semester or a year or more of material--should be tried out over an extended period, with sizeable and representative samples of teachers and school programs.

VI. Administrative studies

Research and development on administrative and logistical problems, related to but not directly a part of the learning process, are essential to the development and refinement of an educational technology. Such research needs to be given a high priority today, particularly when carried out in conjunction with joint development and field-testing programs of the kind indicated in categories IV and V above. A list of illustrative areas follow:

(a) Data processing: Summarization, recording, retrieval and transformation of a large variety of data must be accomplished in an efficient manner, so that procedures in using new media are not too bogged down in clerical problems--e. g., the scheduling of classes in a flexible manner. (Summarization of test scores so that decisions can be made with respect to grouping requires a more efficient retrieval system.)

(b) Administrative planning: Problems of fiscal accounting, planning for enlargement or modification of facilities, estimating future enrollments, predicting need for supplies, and even such mundane activities as bus-route planning, which can have a distinct effect upon the feasibility of any new instructional system.

(c) Use of media: Special consideration must be given to redefinition of the role of the teacher and methods of using different media are required (e. g., logistic problems with respect to allocating time on new equipment limited by available resources). Very complex questions such as what purposes should be established for use of television as compared with teaching machines or language laboratories or films must be answered. Attempting to do so may generate new ways of formulating certain important problems for hypothesis-testing research or field- suitability testing.
In short, a determination of how all the resources available for the instructional process fit together into an integrated system will be considered here.

(d) Maintenance and support: Problems of storage of programs, films, tapes, and other instructional media, repair of equipment, maintenance of apparatus, must be provided for. In addition, a systematic plan must be made for methods of distributing materials from regional or central locations, along with cost of acquisition of these materials and resources.

(e) Personnel training: Professional in-service training and retraining must be considered as a part of this activity. The effect of new technology on morale of instructional personnel must be taken into account if the new technology is to be successfully initiated.

(f) Curricular activities: Another problem is study for the determination of how to phase in new curricular innovations in such a fashion that the total school sequence constitutes an integrated developmental series.

(g) Planning for changes: Careful attention must be given to the practical, economic, and political problems associated with innovating new instructional technology.

A primary criterion for this stage should (as in category I) be the reputation of the researcher--in this case, for novel and effective solutions to practical administrative problems. Sampling of schools should be sufficient to determine the limits of generalizability of findings.

Category C--Dissemination

VII. Demonstration

Demonstration of new innovations are provided for purposes of affording teachers an opportunity to observe technology in an environment comparable to their own. Methods of using new media are demonstrated so that there will be a place for administrators, teachers, and the public to see what the new system is like. These demonstration "experiments" are often mislabeled as "research" because they attempt to compare the new method with some undefined conventional method. The purpose for which demonstrations are justified is an in-service education or dissemination activity.

If demonstrations are to be conducted they should utilize the best available products and information. The procedure used should be based on the best research evidence. So-called "control-group" comparisons should be avoided; such comparisons generate invalid conclusions in the name of science. If demonstrations are to be conducted they should not be disguised in the form of research, but should rather be presented as a means of in-service training.

VIII. Utilization

This activity is promotional and aims toward the dissemination of the new technology in schools on a large scale. This step is devoted to implementation on an on-going basis and does not purport to be research. As in Category VII, support for this activity is of questionable worth, but if undertaken the same criteria apply as apply to Category VII.

SUMMARY

In conclusion, it is recommended that support be provided for projects showing good likelihood of (a) increasing knowledge, or (b) producing a specific, superior and useful product when private sources are not more appropriate. Support for most demonstration studies and utilization projects (Categories VII and VIII) is considered to be of questionable wisdom at present; when support for such a project is considered, very careful attention to the criteria outlined in the text is imperative to avoid premature and largely wasted effort. Material development (Category IV) needs some support, limited to those few studies which will meet the criteria outlined above for public support. Relatively few large field-suitability studies (Category V) should be supported as yet, because the prerequisite conditions for adequate field studies can as yet seldom be met. Administrative studies (Category VI) merit support when they clearly will increase knowledge or provide a useful product. Development of new evaluation techniques (Category III) provides needed new knowledge and is highly worthy of support, but relatively few proposals are anticipated here. Exploratory research and hypothesis testing can, properly conceived, increase our store of needed new knowledge, and should accordingly be given high priority.

Appendix A is a modified version of material prepared by the Joint Committee on Auto-Instructional Programs and Devices.

COMMENTS AND REACTIONS ON PLANS FOR ESTABLISHING REGIONAL LEARNING RESEARCH CENTERS[1]

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1. Justifications for establishment of regional learning research centers with a programmatic orientation.

(a) The essential methodological advantages of sustained programmatic research are the same as those found to accrue to longitudinal research. Illustrative of the unique advantages of longitudinal studies are the following:

- (1) The opportunity to study individual differences as well as group performance, over time and through periods of change, without loss or masking of individual variations in rate of change, e. g. , observation of adolescent spurt in height and weight.
- (2) The opportunity to assess environmental and treatment variables in their temporally successive and interactive influence on behavior, e. g. , long term retention and transfer effects.
- (3) The opportunity to assess the effects of experiential and/or treatment variables on short, intermediate, and long term criteria in realistic cumulative fashion. Administratively, the advantages of sustained programmatic research relate to the opportunities for careful recruitment and maintenance of maximally competent scientific and professional research staff. In addition, such programs permit more deliberate and effective allocation of supporting facilities and funds than is usually possible under the more phrenetic circumstances of short term research.

(b) Problems

- (1) One of the biggest problems that plagues programmatic research in the behavioral sciences is the lack of long-term financing. By definition, research in this area is not easy and a rather prolonged effort is often required even to get minimal results. The apparently slow pace of progress sometimes causes sponsors to feel that no progress is being made and to withdraw support. Hopefully any particular Center that might be established in this program should be funded for five year intervals of time.

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[1] Complex human learning is defined by the authors as referring to those relatively permanent behavior changes manifested by human beings as a result of practice. The term is considered to include skill formation, attitude formation, informational gain, etc. Furthermore, human learning is considered to be the primary process characterizing the behavior of most human beings.

(2) Another problem might be the scarcity of professional personnel who might be employed in the Center. Being a new venture, employment might not be as attractive to professionals as would a more established program. Also, at the start, the professional and social status of Center personnel would not be known and hence the drawing power of the work might not be as great as desired. Also, of course, there are numerous challenging new ventures in other areas of the behavioral sciences and the Center project would have to compete with them for personnel.

(3) If the Center were administered directly by a government agency, this might constitute a problem. It seems generally agreed that government administered projects have more "red tape" connected with them than those run directly by educational institutions or industry. The more direct the government control the more complicated the personnel procedures of hiring, firing, promoting, transferring and reviewing. A similar generalization could also be made with respect to material, purchasing, using, and inventorying. Accounting procedures with respect to both people and things might also be unduly complex under direct government administration. These problems would be somewhat, but by no means completely, reduced if a government contract to a university was the means for establishing and running the center.

(4) There might be some problems of community relations. In order to perform "meaningful human learning" there would have to be sympathy and understanding on the part of the community in which the Center was located. As mentioned below the Center could probably not run without being closely integrated with a local school system or institution. Clearly the winning of the cooperation of such systems and institutions is a prerequisite for the Center's operations. It is also highly likely that other members of the local community, particularly the parents

of the school children, etc., would have to be persuaded as to the desirability of the Center's program.

(5) Sustaining the program would be effected by the reaction of both the community and the nation to the results obtained by the several Centers. Hopefully the appraisal of the progress achieved by the Centers would take into account the difficulties and complexities of social research of this kind. It would be important not to be overly critical of the Center's work.

(c) Making Centers productive.
The way to do this is to create the obverse of 1(b); this would mean that long-term financing would be made available, that competition for staff would be recognized and suitable inducements provided, that every attempt would be made to keep "red tape" government procedures out of the operations either as a government-administered facility or via a government contract, that the cooperation of the Center's community be sought from the first and public effort be directed toward enlisting the community's good will, and finally the Center should produce some real and significant results having import for national educational goals. The administrators of the Center should not be hesitant in selling their results as they become clear. Each Center should also make provision for a periodic review of its activities.

(d) Needs for Centers.
Illustrative of the more pressing needs justifying the establishment of centers, in addition to the existing system of grants for projects in the area of training, education, and learning research, are the following:

(1) Existing grants rarely provide sufficient opportunity for organizing and pooling both personnel and physical resources of several geographically proximal institutions of higher learning for the purposes of such research. The usual result is less than maximal effort and effectiveness of the project.

(2) Existing grants rarely permit the establishment of long term relationships with school systems and other educational institutions for prolonged and continued access to the target audiences and the objects of study.

(3) Existing grants are insufficiently funded to provide the sufficient and necessary resources for maximal pursuit of the research goals, e. g., instrumentation, data processing equipment, etc.

(4) Existing grants rarely provide the opportunities for replication of critical research and/or the follow-up of preliminary, but provocative research findings.

2. Scope of research programs.

(a) It is recognized that there are a number of ways in which the scope of research programs and/or the formulation of significant problems for the proposed research centers could be organized, e. g., allocation of functions in terms of target groups, in terms of research on learning task taxonomy, in terms of currently established classes or situations of learning (e. g. cognition training, attitudinal learning, conceptual learning, etc.). However, the schema which is proposed is considered to have potentially greater integrative power and have a greater likelihood of making systematic contributions to the immediate as well as long term needs (educational) of the country.

It is recognized that the broad missions to be outlined below are not all-inclusive and that a certain amount of desirable duplication between Centers will occur. The first four Centers to be named below, although basically oriented with respect to mission, will clearly have to be sensitive toward the application of their programmatic results.

(1) Center Number One.
The mission of this Center will be to specify and clarify the National educational goals (perhaps somewhat like French's "Behavioral Goals of General Education in High School"). One parameter of these specifications will be the educational level; that is, elementary, intermediate, secondary, collegiate, graduate and adult (it would be hoped here that the rigid differential between these levels would be broken down and perhaps eliminated in many cases). Another parameter of the specifications would be the type of education; that is, professional, technical, vocational, avocational, civic, etc. The possible long range efforts of cybernation should be anticipated here.

(2) Center Number Two.

This Center's mission would be the preparation of programs and program materials in order to achieve the national educational goals specified by Center Number One. Some of these programs might be core programs to be used in all schools regardless of levels or types. Other programs might be specific as to behavioral traits such as verbal capacity, quantitative capacity and subject matter aptitudes. In this last category the programs would differ depending on whether the learning program was for professionally oriented students, e. g. , technical, vocational, etc. Center Number Two should also be prepared to maintain continuous liaison and cooperation with Center Number Four (media Center). An additional major preoccupation of Center Number Two should be in relation to the determination of optimal time periods and schedules of human learning and education, e. g. the feasibility and desirability of 11-month school years, 5-, 6-, or 7-hour school days, etc.

It is recognized in the case of Centers One and Two that some principle which permits reduction or selectivity among the thousands upon thousands of possible educational goals and curriculum programs to meet these goals would have to be established. In light with the principle outlined below substantial autonomy for the determination of such principles ought to be left with the individual Centers.

(3) Center Number Three.

This Center should concern itself with the development and alteration of learning motivated habits. The mission of Center Number Three assumes that the extent of learning is primarily a function of the single individual's willingness to profit from a learning environment. It assumes that teachers don't really teach but that they guide their students to learn and that the only people who really learn are the students. One of the major sub-goals of Center Number Three would be studies on the utilization and preservation of original curiosity. Another goal would be the alteration and acquisition of drives toward education.

(4) Center Number Four.- Tools-of-learning Systems Center.

This would be most concerned with the media of education. It would attempt to exploit all knowledge about present components and systems (e. g. closed circuit TV, teaching machines, new equipment for data storage and retrieval, etc. Programmed textbooks and new type learning experiments.) It would also be concerned with the development of new systems in the light of modern technical achievements. Its work would be closely coordinated with Center Number Two above.

(5) Center Number Five.
This Center would be basically oriented toward the biochemical basis of human learning. It may be that we are on the verge of a breakthrough in this particular area as witnessed by some of the contemporary studies on psychopharmacology and the apparent self reinforcement efforts of brain stimulation on animal behavior. One sub-program which should be carried on in this Center would be the effects on learning of contemporary biochemicals. Another program would be biogenetic studies. A third program area should be work with the mentally retarded and related problem learning involving organic pathology.

(6) Center Number Six.
The mission of Center Number Six is conceived to be concerned with basic research and theory development at the behavioral level. Though it is hoped that each of the Centers above, particularly Center Five, would have the opportunity to pursue such basic research as is deemed relevant to their more specific missions, only Centers Five and Six are seen as primarily basic research units. And, whereas Center Five is biochemically and biologically oriented, Center Six is seen as being behaviorally oriented. A critical goal of Center Number Six is seen to be the development of theory for use by both the behavioral scientist and the educator in guiding human learning. Illustrative of the types of research that might be pursued by Center Number Six is the identification of the dimensions of human learning. It might be concerned with a set of studies on the relation to present known dimensions (e. g. I. Q., creativity, special motor skills, etc.). It would also conduct studies on presently uncorrelated dimensions.

(b) Educational levels.
As stated above, it is anticipated that there would be a de-emphasis on the educational levels by the respective Centers as American education is now organized, except perhaps in the area of adult

education, which, of course, is hardly a level at all.

(c) The proportionate emphasis on basic-to-applied continuum of research. As has been expressed above, although Centers Five and Six are perceived as the basic research centers and Centers One through Four as having more direct and immediate application, it is hoped that Centers One through Four will have the option to pursue limited basic research studies when they are particularly relevant to their mission.

(d) Differentiation between Centers.
This would be accomplished as per 2(a) above.

3. Facilities and instrumentation.

(a) The requisite instrumentation facilities for each of the centers would vary in terms of their explicit missions. For example, Center Number One conceivably would require no special facilities beyond office space for a professional staff, a substantial library, and some supportive office equipment, e. g. duplicators, etc. However, Centers Two, Three and Four would have need for substantial interaction with numbers and varieties of educands. These Centers would require research space (i. e. space in which educational experiments could take place). It would be extremely difficult to specify in advance detailed facility and instrumentation requirements for these three centers (Two, Three, Four). However, certainly some data processing and computer equipment would be required. Indeed if a particularly elaborate research program were to be necessary a simulation facility might also be necessary.

In general, it might be advantageous to think solely in terms of the construction of new buildings for these research centers. Such new construction, in addition to providing the necessary space, would also permit the direction of attention to and the marshalling of interest and support for the learning research centers in their respective communities and from the relevant sciences.

(b) Depending on circumstances and the specific needs of some programs of research, the needed kinds of instrumentation and research facilities might include the following: classrooms with one-way viewing screens; motion picture and sound recording facilities; response recording devices ranging from pencil mark IBM sheets through elaborate electromechanical devices designed to record subjects' selection of answers to special projected testing procedures (classroom communicator); etc.

Obviously Center Four (Tools-of-learning Systems Center) would require the total spectrum of materials and equipment designed to aid learning, e. g. slide projectors, tape recorders, "teaching machines," simulation computers, production facilities, etc. In addition, this Center should have access to an educational and/or closed circuit television system and radio system.

(c) It follows from the general characterization of missions of Centers One through Four that these Centers will require long term intimate and broad relationships with institutions and agencies offering and/or committed to education, e. g. public school systems, college education programs, continuing adult education programs, technical education programs, etc. These relationships should include the capability of instruction being carried on by the members of the learning research center or at least under its complete and extended supervision.

It is assumed that provision would be made for continuous progress reporting as well as terminal sharing of completed research by all the research centers.

It is suggested that certain mobile classroom-type facilities and/or data recording and processing facilities be developed to serve the learning research centers. Such mobile facilities would prevent the necessity of bringing all subjects for research purposes to the site of the learning research center. Such facilities would furthermore have the capability of being loaned for periods of time to individual learning research centers which may have lesser rather than greater use for them. Such mobile facilities would tend to add a dimension of realism to the research (i. e. learning would be studied in natural settings).

4. Staffing, Organization and Administration

(a) Kinds of Research Personnel

Although it is not expected that each Center would have at least one of the kinds to be named below, it is strongly urged that at least half a dozen of these types be available at each Center:

(1) An educator-philosopher

(2) Educational philosophers

(3) Statistical model and computer experts

(4) Learning technology experts

(5) Educational sociologist

(6) Behavioral scientists (learning psychologist)

(7) Clinical counselors

(8) Systems simulation experts

(9) Behavioral biologist

It is expected that under certain circumstances the classes of competencies reflected above would have to be augmented in various ways, e. g. Center Number One may require a small but highly qualified group of scholars, Centers Two and Four would require special groups of subject matter experts and individuals experienced in classroom teaching.

(b) Size staff (for one Center)
The minimal number of professional-type personnel in each Center is estimated to be approximately 10. The kinds of professionals will clearly differ from Center to Center depending on the mission but they will presumably be the type named in 4(a) above. The ratio of professional to supporting staff should be approximately 1 to 4; hence for each ten professionals there should be about 30 technical and 10 general supportive types.

(c) Are they available?
The answer is Yes, with the proper inducements. They would have to be obtained by stealing and pirating them away from their present interesting positions. If the Centers really make a go of it, new people would be selected and trained in the present training institutions in response to this new national interest. (Training responsibilities may very well be assigned within each of these Centers for the development of new personnel.)

(d) Related to Universities?
It is most preferable that the Centers be related to universities but they should not necessarily be physically located on university campuses. The important thing is to have the Center located and integrated with the learning community of which it should be an accepted part.

(e) Interdisciplinary?
Clearly so as implied above.

(f) Inter-university cooperation?
Such cooperation is both possible and very desirable, if not mandatory. Not enough inter-university cooperation goes on now and a massive effort of the kind described here might provide the indirect benefit of promoting more cooperation between the educational institutions of a given region. The Boston area is a place where such cooperation is much needed. An interesting case of cooperation is exemplified in the description of NEW COLLEGE and the recently instituted new programs involving Amherst, Smith, Mount Holyoke, and the University of Massachusetts.

(g) How administered?
There should be relatively great local autonomy within each Center. The staff should have considerable latitude and freedom in developing and running their studies within the framework of the Center's overall mission. Each Center would have a director who hopefully should be a research or professional person with administrative capacity.

(h) Coordination of Centers.
It is proposed that all the Centers would be coordinated by a national board. Among the members of this national board would be the directors of each Center, representatives from the U. S. Office of Education, Congress, local, state and community individuals including school administrators and superintendents, local university presidents, etc. Administrative action by the local board would be accomplished by an Executive Committee of a much smaller number from the total board personnel.

5. Location of Centers

(a) Criteria for selection of locations.

It is suggested that the following criteria be considered in the selection of Centers.

(1) Availability of a learning community

(2) Local university to administer

(3) For Centers Two and Four particularly - available TV and radio network

(4) Attractive to professional staff

(5) Computation equipment and facilities available

(6) Cooperative social, civic, and political organizations within the community

(7) Target audiences (educands) ought to have some degree of stability for longitudinal studies

(8) The applying institutions should have a history of successful interaction in cooperative endeavors with other educational institutions and systems

(9) The applying institution should have a willingness to commit itself to a long range role in the area of learning research

(b) How many, and when?
It is recommended that there be eight Centers established: One of each cited in 2 above, with the exception that Center Number Two and Center Number Four be established in duplicate. It is further suggested that two be established in 1962 or 1963; that these two include the equivalent of Center Number One and Center Number Four described above. In successive years Centers Two, Three, Five, and Six be established.

6. Financing

(a) Level of financing .
It is recommended that the Centers as they establish be totally financed and that such financing be the same for each Center.

(b) Sources of financing.
It is suggested that the financing be provided by a variety of federal and state governmental agencies, philanthropic foundations, and industrial sources.

(c) Duration of financing.
It is strongly recommended that all financing be for a minimal five year period. The expenditure of funds during an initial five year period might be as follows:

First year - director, program heads, and skeletal supporting staff acquired and preliminary plans developed within the learning community.

Second year - pilot studies might be undertaken, recruitment of professional and supporting staff would be completed.

Third year - full scale studies would be initiated; installation and development of data processing equipment would be completed, etc.

Fourth year - continuation of full scale programs, with the beginning of a continuing program of evaluation.

(d) Adequacy of sustained support.
It is suspected that complete support is currently available and would be continued in its availability if appropriate governmental agencies and foundations realized the significance and promise of the proposed programs. It should be recognized that although the basic premise is that the proposed establishment of these centers would supplement and complement existing funds and programs in the area of human learning, that in reality they would become a mechanism for the rechanneling of such research and such support. The very agencies and the very personnel currently engaged in supporting and executing short term research could not help but find their way into the proposed long term programs of research.

7. Summary Statements.
Particularly as a result of its short term character, much of the previously accomplished and currently pursued research in complex human learning leaves the behavioral scientist and educator with serious unanswered questions concerning the determinants of complex human learning. In addition, the general lack of long-term support and the nonprogrammatic character of current research prevents the recruitment and maintenance of highly competent staff which are so necessary to attack in a significant manner the many fundamental questions that need to be studied.

Were long term programmatic learning research centers to be established, it is considered critical that they concern themselves with the following kinds of issues:

(1) The specification, in behavioral terms, of educational and training goals necessary to achieve the broad purposes of the society and the nation.
(2) The preparation of the most appropriate program content, instructional methods, and tools for learning for the accomplishment of such behavioral goals.
(3) The pursuit of understanding and successful manipulation of the determinants of curiosity and other motives compatible with and necessary for learning.
(4) The pursuit of research regarding the neurophysiological and genetic determinants of complex human learning, with particular reference to the known classes of organic pathology limiting learning.
(5) The continuation of imaginatively conceived and rigorously pursued formulation of basic theory related to human learning phenomena and educational practice.

All things considered, no process other than learning is more appropriately manipulated in the preparation of the members of a democratic society to adopt their adult roles. Furthermore, no process other than highly successful learning, better prepares a democratic society to meet challenges and to pursue social change. It follows that efforts necessary to extend our understanding and control of complex human learning are essential if we are optimally to prepare the members of our society for future as well as current social challenges.

DEVELOPMENTAL PROBLEMS FOR A LEARNING RESEARCH CENTER[1]

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Some Inadequacies of Earlier Experimental Research in Education

A half century of experimental educational research has paraded an amazing array of statistically non-significant differences. Such research should be viewed as research on complex learning problems. Complex learning problems may be treated as multi-variate problems.

That experimental educational research has not more frequently resulted in positive findings (that is, statistically significant differences) may result from two principal factors:

1. Relatively few significant variables account for much of the variance in achievement. Because these important variables are seldom in the domain of the experimenter, they are the ones that are usually controlled rather than used as primary variables in experimental research. They include: maturity (age level), brightness (intellectual level), and socio-economic status (a composite or parental intelligence and education, and opportunities afforded by family income). Furthermore, these significant variables: (a) are complexly interrelated themselves; and (b) form the nexus out of which learning occurs.

Another antecedent variable of major importance is so complex and indefinite that it is described as "individual differences" in initial status and often allowed to enter experimental error in an experiment. It is a composite of the individual's previous learning history and the effects of those aspects of his environment which have been psychologically relevant to him - his life space.

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[1] The tactic of this paper will be to present the argument in a series of core statements rather than to expand these points fully. Each of the points made, however, could be discussed, with evidence adduced to support the concepts presented.

The remaining variables - the ones generally used as independent variables - include method of instruction, type of content, teacher personality, enthusiasm and skill, materials and books available, etc. Collectively, they contribute less than age, intelligence, and social background to achievement. These are complexly interrelated in varying degrees, and interact intermittently over time with the learner so that their consistent effects are difficult to measure. Indeed, they may have "cancelling" effects on one another in unsuspected ways. Their effects are presumably most apparent when consistently applied over periods of time.

2. The second important reason for inconclusive results of experimentation arises from the point just made - that many of these effects require time to appear. Characteristically in educational research the time span of treatment has been limited to a unit or at most a semester of work. Indeed, the primary variables which account for the bulk of achievement variance, make their effects apparent over lengthy periods of time.

The popularity of the short period of experimental treatment, apart from practical considerations, arises from the dominance of the single variate model for experimentation which education inherited from an older physics, and which continues to influence our attempts to handle multi-variate situations experimentally. It is a bold experimenter in the psychological laboratory who attempts to handle more than three independent variables simultaneously.

These considerations put research on complex learnings squarely into a framework with which developmental psychology has long been concerned. This framework includes several important components:

1. The span of time required for developmental (i. e. , learning) effects to show;

2. The child's previous learning history;

3. The composition of the child's "life space" or the psychologically relevant environment;

4. The context in which development occurs.

The effect of these components is to suggest that a transactional or ecological model may be more appropriate than a simple response model.

Developmental and Experimental Research Strategies and Problems

There are a number of reasons why the developmental psychologist, although possibly possessing a greater awareness of the complexity of issues than some of his colleagues, has not contributed much to the achievement of complex, multivariate experiments:

1. The developmentalist has been characteristically interested in considerably longer time intervals than the laboratory experimentalist. It is a moot point whether there are organizational processes in behavior which cannot be replicated in the miniature "developmental" reconstructions possible in the laboratory. Such processes have been assumed, such as the dependence of learning upon neurological or structural changes which come with physical growth or maturation, upon distribution of practice over long periods of time, and upon the interaction effects of complex configurations of stimuli which defy laboratory replication.

2. The developmentalist's intellectual tradition has been that of the descriptive sciences. He has been interested more in understanding than in prediction and control. He seeks understanding through comprehensive description. The costly task of keeping in touch with subjects over spans of time to obtain adequate description has left him no time or resources for the more complex task of maintaining experimental controls over long intervals. Moreover, on complex problems the developmentalist has not been intellectually ready to experiment; he has sought first to comprehend the many factors involved before moving to the stage of experimentation. He has generally confined his experiments to simpler forms of life (e. g., experimental embryology of salamanders or chicks) and to relatively simple issues for which parameters are rather well defined (e. g., effects of dramatic physical insults to physical growth).

3. Longitudinal studies, one of the important methods of the developmental psychologist, have been unpopular. The common complaint is they are too costly and take too long to produce results. (It should be pointed out, however, that the sums invested in longitudinal research are small by present day standards of financing research.) Yet some kinds of questions can only be answered at our present stage of knowledge by following up the same individuals through time. The study of process, the organization of complex systems over time, requires that we study

those systems in process.[1]

4. The developmental psychologist has been interested in complex, multi-variate problems. The tradition of the single variable research has been strong in experimental psychology. The statistical innovation of variance analysis has limitations when applied to multi-variate problems as broad as those with which developmentalists have been concerned. Theoretically promising multi-variate methods (e.g., multiple factor analysis) now possible by means of high speed computers, are limited by the fact that precise instruments are not available. When basically unreliable observations are thrown into a correlation matrix, the results must necessarily be limited. One cannot get out of such a matrix more than he puts into it. Furthermore, a danger in this method clearly apparent in contemporary research literature is the uncritical procedure of assessing factors from masses of data without the development of adequate theory for the inclusion of variables in the first place.

5. Psychologists are constantly looking for innovations; this emphasis has led to the multiplication of instruments and methodologies without the full exploration and development of any one instrument or method. The intelligence test is virtually the only instrument which has been developed and evaluated in depth.

6. For a generation, developmental psychologists along with others interested in personality have concentrated on affect and adjustment considered subjectively rather than on performance and achievement, considered objectively.[2] In personality study in particular there has been a continuing proliferation of instruments with the result that our knowledge in this area is most incomplete, and unorganized.

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[1] There is, perhaps, a more telling criticism of the longitudinal study than cost in money or time. If the individual be considered an open system, importantly influenced by the social context, and that context is known to change unpredictably over time, how do we analyze the system-context transaction, to derive principles leading to prediction and control?

[2] Indeed, there is reason to suspect that ability or performance factors organize differently over time - perhaps more rapidly - than affect or personality factors. Certainly there are different problems of metrics in problem solving and performance than in subjective evaluations of personal experience.

Educational Experimentation and the Developmental Model

Public schools have for years kept records, but these records have been primarily for descriptive purposes rather than for basic research. It is shocking that so few long time studies of school achievement have been made, when standard tests have been in use for almost half a century. Developmental psychologists have not communicated their concepts and strategies to educational researchers.

It is now time to make an experimental approach to education on a large enough scale to assure adequate testing and records, and over a long enough time to measure the cumulative impact of influences. Instruments for appraising achievement and performance are sufficiently good that positive outcomes are more certain in this area than in the area of personality and attitudes. Moreover, we have learned to design research on a scale sufficient to provide adequate controls over a period of years. Such a plan, however, must be carried forward in the community context where there are children.

The need for an experimental program contructed around the developmental model is obvious. Courtis long ago argued this point of view at the University of Michigan, but few paid attention to him. Super's and Flanagan's programs are virtually unique, and theirs are primarily descriptive.

Developmental Concepts of Importance to Educational Theory and Experimentation

Speculation based on developmental study and concepts offers a number of ideas which would be important in the selection of problems and the design of studies. These are, very briefly:

(1) The concept of development as manifestation of intrinsic growth is gradually giving ground to the concept of development as an accumulation of long term learning processes. Hebb's distinction of early and later learning is relevant here. That the effects of particular short time experiences may not seem readily demonstrable may result not so much from the fact that the organism is controlled by intrinsic growth forces as by the fact that the consequence of long time learning processes are massive and overwhelm the impact of any one short time influence.

(2) In the developmental process conceived in this manner, there may be interactions between the organism and ecological factors such that there are "critical periods" (not too narrowly defined in time, perhaps) when a more rapid shift or relatively more rapid reorganization of skills and performances may occur.

(3) Even granting this revised notion of development there are definite limits to the shaping of the organism through experience alone. If intrinsic growth factors do not produce developmental behavior changes, they may very well set limits to acquired or externally produced changes. The phenomenon of adolescence can be illustrative. Many so called psychological and personality adjustments of adolescence are more closely regulated by bio-chemical factors controlling physiological maturity than by social-contextual or age factors.

(4) In contrast with the more commonly conceived convergent effects of experience there may be significant divergent effects. Events may at a particular time head the learning of the organism in one direction rather than in another. These are often unpredicted and can only be discerned over time, and in retrospect. The identification of such events, their occasion, their properties, and the prediction of their effects may be very important in complex learning and in social processes. They must be predictable if they are to be incorporated into science.

(5) The concept of developmental task, or the fulfillment of one level of organization before another level of organization or performance becomes possible, has important implications. These implications may be quite as important for the organization of the social system designed to produce learning (the school and the curriculum) as for the individual who is learning.

Problems for Research

Within the framework of developmental concepts as outlined, a number of general problems can be listed. These problems could be attacked with hope of some success in an Institute or Center which commands sufficient resources to undertake programs of study in a large number of schools assuring that experimental groups and control groups can be present in enough instances and for a long enough time to assure adequate scientific controls. The focus on performance rather than on personality, considering the state of our instruments and methods, is a much more promising one.

We already have sufficient knowledge to undertake a number of significant experimental studies. In addition, there are a number of important descriptive and normative studies, necessary to later experimentation which would likewise be profitable. In the third place we require certain basic observational studies - exploration with the purpose of "hypotheses finding." Some of these are suggested below: - many more can be suggested by psychologists and educators.

Suggested Research Areas

There are some areas wherin we are ready for systematic experimentation. Sufficient observations have been made, theory has been formulated, measuring instruments and appropriate instructional methods have been constructed. Some examples are:

1. The experimental investigation, over several years, of psycholinguistic theory applied to the teaching of reading.

2. Comparison of two or three conceptually different approaches to mathematics understandings.

3. Comparison of enriched general science instruction in the elementary grades, with and without manipulation and experiments on phenomena by children themselves, on science knowledge and understandings in senior high school.

4. Exploration of the optimal arrangement of positive and negative instances of generalization in concept learning.

5. Comparison of effects at high school graduation on general education as well as on specific linguistic skill, to language introduced in elementary grades with language introduced in high school.

6. Effects in junior high school of introducing reading instruction in kindergarten, in first, and in third grades.

7. Follow-up, in adult life, of TV enrichment in elementary grades.

There are some areas which require empirical "mapping" to locate hypotheses before suitable experiments can be planned. Observational methods exist, but we need to explore the dimensions of selected behaviors, to find the varieties of end ranges of performance. A knowledge of the parameters of behavior as it exists permits selection levels at which to begin experimentation. In these areas descriptive and normative studies and surveys are appropriate. Such studies might include:

1. Vocabularies and concepts in the social sciences as understood and used by children.

2. The optimal conditions for learning, including appropriate definitions of "optimal." (A survey here may include a large number of rather specific but small scale experiments. The overall task is one of "mapping," however.)

3. The relation of learning rate to aptitudes, both maximal rates for given levels or ranges of aptitude, and optimal rates in the context of the other learnings commonly expected concommitantly. (Again, the definition of "optimal" may require a program of small experiments. The overall problem, however, remains one of logistics.)

4. The conditions for retention and transfer over stipulated intervals of time. (Here we mean long-term, "developmental" retention.)

5. The nature of mental growth. (Pinneau has recently suggested that there is a correlation between initial level and subsequent mental growth increments.)

Finally, there are some areas in which surveys more coarse than those described above are necessary before dimensions of behavior can be mapped. In these areas fairly unstructured but shrewd and sensitive observation is required to provide basic material out of which appropriate observational methods and instruments can be constructed, and hypotheses systematically formulated. Such areas are truly "pioneer," "new insight" areas, and might include:

(1.) The identification, at the molar level, of educational "readiness" for introduction of complex learning.

(2.) The variety of ways in which young bright children as contrasted with average children form empirical concepts from the "givens" of daily experience. (This problem can be attacked experimentally under the circumscribed conditions of the laboratory, but there are reasons to believe the observational approach to molar processes may be helpful to education, also.)

(3.) The formulation of concepts of motivation; the definition of interest, and dimensions and parameters of children's self-selected activities; the omission rates of "spontaneous" behavior.

PROPOSAL FOR AN AUTOMATED LEARNING AND TEACHING LABORATORY WITH RANDOM ACCESS TO PROGRAMMED MATERIALS

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1. Purpose.

The purpose of the laboratory proposed in these pages would be to provide a major research tool for the study of higher learning processes in school age children. In recent years advances in learning theory has suggested the feasibility of developing mathematical models of the teaching process. In terms of such models one can derive schedules and methods for presenting instructional material that optimize the efficiency of the learning process. The primary focus of the laboratory would be to investigate in detail the increased efficiency and depth of learning that can be obtained by specifying optimal learning programs for the individual student and to test the extent to which material organized on an individual student basis can successfully simulate the relationship between a student and a teacher. In order to conduct research on optimal programming methods it will be necessary to construct a laboratory designed around a computer-based classroom facility that would give the experimenter high-speed flexibility in scheduling auditory and visual information and in recording responses for individual students. Thus, the research laboratory proposed in this paper would be directly tied to a digital computing facility. The computer would be used both to sequence and schedule instructional material for the individual student and also to record and analyze the student's responses.

2. Justification.

To carry out the type of research program necessary to develop and test a normative theory of the learning process it will be necessary to establish a computer-based laboratory of the sort described above. From the technical standpoint, there are many problems involved in building and programming a rapid random access device for the presentation of instructional material and the monitoring of the subject's responses. However, it will become clear in our description of the proposed research program, that the purpose of the laboratory is not only to develop the appropriate computation facilities to simulate a teacher-student relation but primarily to use the computational facilities to conduct research designed to obtain a fundamental understanding of the learning processes; in particular, of those processes pertinent to the acquisition of complex intellectual subject matter.

We have had extensive discussions with engineers and computer specialists at the Stanford Research Institute (Menlo Park, California) concerning the development of a computer-based learning laboratory. If the facilities were designed so that, for a given experiment, fifteen to twenty subjects could be run simultaneously through complex sequences of instructional material, then it is estimated that the minimum cost of the laboratory would be in the order of $750,000 to $1,000,000. If such a laboratory were established at Stanford University it would be necessary to have direct access either to the IBM 7090 or the Burroughs 5000; both of these computing machines are scheduled to be installed in the near future. The development of a laboratory of this magnitude in terms of existing grant structure in education would be extremely difficult if not the impossible.

3. Scope of Research Program.

A main focus of the laboratory's research would be the application of quantitative and mathematical theories of learning to complex cognitive material. We list at this point some of the general problem areas we consider both significant and practical to investigate in the near future.

Concepts of Elementary Mathematics. The array of mathematical concepts that it is possible to introduce in the elementary schools (grades 1-6) provides an excellent set of materials for experimental investigation. It will be useful to list some of the more important problems that could be studied with respect to this type of material by the use of a major laboratory facility. A central problem is the optimal sequencing of mathematical concepts. A typical scheme for using the learning laboratory with rapid random access to instructional material is to organize the sequence of concepts to be learned in such a way that at each stage of development the student is required to satisfy a behavioral criterion of learning. Mathematics is the one subject matter in which there is perhaps the most common sense evidence of transfer of learning from one concept to another. It would be impossible, for instance, to begin with differential equations rather than arithmetic. On the other hand, experimental studies have never been conducted that investigate the nature, extent and character of the transfer involved in the learning of a body of mathematical concepts. It should be evident that the selection of optimal schedules for introducing mathematical concepts is almost identical with the scientific problem of specifying the variables that determine the amount and type of transfer possible from one set of concepts to another.

To make these ideas somewhat more concrete consider a list of concepts introduced in Suppes' workbooks for elementary school mathematics. The list of concepts for Grade 1 is as follows: sets, identity of sets, union of sets, number of things in a set, addition of numbers, numerical variables, place value notation, difference of sets, subtraction of numbers, subset relation (optional), less than relation for numbers (optional). The mathematical or logical structure of these concepts does not dictate the precise order in which they must be introduced. For example, either of the following two orders make mathematical sense. On the one hand, we may introduce difference of sets and the subset relation prior to the introduction of numbers. This represents one extreme in which concepts of set theory are introduced prior to any of the number concepts. The other order is to present the notion of number of things in a set (and therefore the number concept) prior to the introduction of the union of sets and immediately after the introduction of the identity of sets. In terms of experimental evidence it is a completely open question as to which one of these extreme arrangements of the material would provide for optimal learning. As indicated, the sequence used at present does not conform to either of them, and it may be that an intermediate case is indeed the optimal one.

There are many important subsidiary problems that arise in an investigation of procedures for optimizing the learning rate. For example, what degree of over learning is necessary for concepts placed at the beginning of the sequence so that mastery of them is sufficient for the learning of more complex concepts later? Put another way, how strict should the criterion of learning be as each new concept is introduced in order to guarantee mastery of the full array of concepts, particularly for concepts introduced early in the sequence? Also, to what extent is it desirable to use response latency criteria rather than number of errors to dictate the optimal way to branch among the various types of instructional items? This problem is particularly important when one specifies criteria that would, in the ordinary sense, produce a reasonable degree of over learning.

Mathematical Proofs. The problems involved in teaching students how to do mathematical proofs is a central topic in the pedagogy of modern mathematics. Systematic research on this problem requires the use of large scale computer-based facilities. What is particularly important is to have devices on which the subject can make a free response and then have the computer evaluate the validity of the response. Present programmed instruction workbooks dealing with mathematics are perhaps most ineffective in their treatment of mathematical proofs; undoubtedly this difficulty is inherit in the programmed workbook format. It is impossible to give the subject a genuine range of possible responses and yet provide, within the limited resources of the workbook, means of evaluating the correctness or validity of the subject's response. It is precisely this kind of flexibility that can be obtained by use of computing machines geared to provide rapid random access to instructional material.

It may be remarked in this connection that fairly simple mathematical models for response compounds show considerable promise of accounting for the behavior of subjects when giving proofs for simple mathematical systems. The mathematical theory of learning that naturally stems from the present simple compound response models of statistical learning theory would be a primary tool for the investigation of learning in this area.

Language Learning. As the tentative description of the laboratory given above indicates, the computer facility would be organized so that at any point in time a visual and/or auditory display could be selected from a large pool of items and presented to the subject. The selection of the particular information array would be based on the subject's performance on past items. The requirement of being able to have rapid access to auditory as well as visual information is particularly important if we are to study the acquisition of second languages and also to conduct research on reading skills with children. In this paper, we shall discuss only the role of the computer-based laboratory in the automated teaching of a second language but the same types of problems arise in research on the acquisition of reading skills.

The present language laboratories are handicapped in two major ways; first, they do not provide behavioral criteria for accomplishment; secondly, they do not have random access to instructional material. As a result they cannot begin to approximate an optimal organization of material for the individual student. From experimental evidence now available it seems apparent that latency time measures will turn out to be particularly important in the study of second language acquisition and will provide a behavioral criteria of performance. Unfortunately it is a familiar fact in experimental psychology that extensive, large-scale studies of latency measures involve major laboratory facilities both for the collection of appropriate data and for the analysis of it once obtained. A discussion of the laboratory proposed in this paper points out that major computing facilities for the analysis of data obtained in the laboratory are equally as important as the use of computing facilities to control and sequence the instructional materials.

4. Facilities and Instrumentation.

It is our suggestion that a laboratory concentrating on quantitative and mathematical learning theories with applications to complex intellectual material should be the focus of one of the proposed regional research centers. Presumably a laboratory with this kind of emphasis would be established around a university faculty whose major interest is in this area. Because of the faculty concentration on mathematical studies in the behavioral sciences at Stanford University, we have proposed that such a center or laboratory be set up here. To establish the kind of laboratory outlined in this paper, it probably would be necessary to construct a building in which to house both the computer-based experimental classroom and office space for research personnel. This building would ideally be located close to the new computing center at Stanford University. The construction of the building would be included as part of the cost of the laboratory.

In the appendix[1] we have included a fairly detailed description of the kind of computer-based instrumentation we would require. The specific proposals made in this appendix in no sense are meant to be final but are simply suggestive of the kind of technical equipment that would be desirable.

5. Staffing, Organization and Administration.

The senior research personnel of the center would probably best be selected from the University faculty. In addition to faculty members, a sizeable supporting staff would be necessary consisting of younger experimental psychologists and a minimum of four or five full-time programmers. The programmers would be necessary both in the preparation of visual and auditory stimuli and in the analysis of data from experiments. The present personnel of the Institute for Mathematical Studies in the Social Sciences at Stanford are highly experienced in the use of computers to control experimental procedures and to carry out large scale analyses of data.

It is our proposal that the laboratory should be constructed at Stanford University, and be under the University for administrative purposes. The primary reason for locating the laboratory at a university is the difficulty of obtaining first-rate scientific talent if one cannot guarantee a direct university connection. It is anticipated that the laboratory would be inter-disciplinary in the sense that educators in the substantive fields under study (e. g. , mathematics, reading, and foreign languages) would be consulted. Further, the faculty of mathematical statistics at Stanford University would be consulted in connection with problems of statistical estimation and testing of hypotheses. In this regard it would be desirable that a full or half-time faculty member from the Department of Mathematical Statistics be associated with the laboratory on a permanent basis.

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[1] Editor's note: Appendix follows the text of this paper.

6. Location of Centers.

As is evident, this proposal is written around the conception of locating a major research laboratory for learning at Stanford University. In our minds, the most important criterion for the location of the center is access to scienfifically trained faculty interested in the problems of the laboratory, If funds were available, the laboratory proposed in this paper could be launched in 1962. It would take the entire academic year, 1962-63, in order for the laboratory to become operational. Roughly speaking we would estimate that approximately a year would be needed to design and construct the laboratory.

7. Financing of Laboratory.

As indicated above, the anticipated cost of such a laboratory would be $750,000 to $1,000,000. It would be our estimate that an annual budget of this same order would be necessary to operate the laboratory at the appropriate level. We have not attempted to work out a detailed budget for this report. It may be that a somewhat lower figure would suffice for the operating funds once the laboratory was constructed. In view of the complexities of designing such a laboratory, it is absolutely necessary that financing for a number of years be assured before construction is undertaken. A minimum commitment of five years would be necessary to make the project feasible in terms of the faculty time needed to design and organize the facility.

8. Summary Statement.

We propose that a research laboratory be established for the quantitative study of higher learning processes. In recent years advances in learning theory have indicated the feasibility of developing mathematical models of the teaching process. In terms of such models one can derive in an exact fashion schedules and methods for presenting instructional material that optimize the efficiency of the learning process. The major focus of the laboratory would be to investigate the increased efficiency in learning that can be obtained by specifying optimal instructional programs for individual students. At the present time, there are a number of general areas we consider both significant and practical to investigate within this general framework. They are as follows: the learning of elementary mathematical concepts by school-aged childred; research on problems involved in teaching students how to do mathematical proofs; research on the acquisition of reading skills in young children; and the acquisition of a second language. In order to conduct research on optimal programming methods, it would be necessary to construct a computer-based classroom facility that would give the experimenter high-speed flexibility in scheduling auditory and visual information and in recording responses and latencies for individuals subjects. Thus, the research laboratory proposed in this paper would be directly tied to a digital computing facility. The computer would be used both to sequence and schedule instructional material for the individual student and also to record and analyze the student's responses.

APPENDIX

The proposed facility for experimental study of machine augmented teaching must be designed to integrate three basic functions.

1. Presentation of visual cues.
2. Presentation of auditory cues.
3. Recording of subject's response.

In order that the student will function as if he alone were communicating with the central computer, it will be necessary to find methods of time sharing the central equipment without appreciable delays between operations. At the same time, the display systems must be able to present material almost at random.

It would appear that these two requirements can be made compatible for the visual display and response equipment. The most obvious approach is to use a typewriter mechanism such as a flexowriter to perform both operations. Because this equipment operates at relatively slow speed with respect to the computer clock rate, it should be possible to provide standard buffers to incorporate up to 25 students in the experiment without noticeable time delays.

The use of typewriters may cause undesirable restriction to the data format. If a more flexible display is required, some of the advanced electronic display systems could be considered, for instance, storage tube displays. Other possibilities are film-strip projection and microfilm on punched cards. The use of geometric displays for instructing computers has recently been announced and may have some application here.

The greatest advantage of a typewriter system is that such equipment is commonly used to address computers. This type of equipment would probably require the least amount of engineering modifications.

Random presentation of audio phrases could be a much more difficult problem than visual display. A loudspeaker does not have the inherent storage characteristics of a typewritten page or the face of a display tube. It will be necessary to take one of two approaches: (1) individual magnetic-tape systems for each student, to provide the necessary buffer storage or (2) provide each student with a complete library of audio information.

The first alternative requires that the tape units have two-speed ranges, one extremely fast speed for entering data into temporary storage and the normal playback speed. The high-speed range must be fast enough so that all students participating in the experiment can share the central audio storage without appreciable time delay. The central storage tape requires extremely high search rates and readout speeds in order to keep time delays to a minimum.

The second alternative of a complete library per student may be a very economical one. Equipment similar to fully automatic record players or cartridge tape recorders could be used to store up to say ten different trial sequences. The tape-recorder system would have particular advantage in simplifying the controls when the system is operating in a "self pacing" mode. However, such an approach creates problems in preparation of material.

A device which may deserve careful consideration is equipment designed by the Haskins Laboratory. This equipment is intended for use by the blind for reading books. It takes teletype punch tape as an input and generates the associated audio.

Much attention is being given to the real-time interconnection of computer and humans. Many of the techniques that have been developed should benefit this project. Particular consideration should be given to the studies now in process at the Lincoln Laboratories and the MIT Computation Center.

PLANS FOR ESTABLISHING REGIONAL LEARNING CENTERS

Lester Beck
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(1) Justification for Establishment of Regional Learning Research Centers with a Programmatic Orientation

(a) What can sustained programmatic research accomplish that is not being accomplished adequately by individual research projects and grants programs? What are some of the advantages of continuing research programs?

We are aware that the National Defense Education Act recently has been extended for two years by Congress. Now any programmatic research program would surely have a longer time perspective than two years. If we could get learning research centers established, it would then be possible to plan ten or twenty-year programs. We are all aware that studies of human abilities have shown that the organization of abilities changes with time. Factor analytic studies of the organization of the intellect in children six years old indicate that not the same factors are pre-eminent as those in youngsters twelve years or sixteen years old. We must, therefore, be able to take a longer look at behavior, and this can be done only where we have sustained research projects over a decade or more. Let me say at this point, too, that learning is the most important aspect of all human behavior: it is the very essence of life itself. Learning differentiates between men of equal ability, and it certainly separates man from the primates; and if learning is so important -- as it is -- then we should direct huge resources toward the investigation of learning since it is basic to our achievements everywhere: achievements of great moment such as conquering space, cracking the atom, and solving human problems on a national and international scale.

(b) What are likely to be some of the problems of programmatic, sustained research and how might they be solved?

One realizes immediately that there have been fairly large programs of research in the military, and these programs have been subject to cut-backs. These programs are not very secure, and this is a risk which the research centers might suffer. If there is this risk -- if a research center may not be supported fully, financially over a considerable period of time -- then it is going to be difficult to recruit high-level personnel. And high-level personnel are essential to the operation of a research center with a vista. One or more centers could possibly be supported in the same way as the Primate Research Center here in Portland, Oregon, so they would attract top notch personnel who are willing to make a career of research. But after obtaining personnel there is the additional problem of deciding which projects are to be carried on and what priority is to be given to these projects. It would appear that some kind of advisory council to the research centers would be necessary, not that the advisory council would dictate the particular projects but rather that the council would see that a full range of prôjects was considered.

(c) How can the research centers be made most productive?

I think I have covered that in what I have already said: productivity depends upon morale, upon a fairly long-time perspective, and upon the quality of the people employed. There must be, therefore, a pretty solid foundation for these research centers to be productive. Productivity will also be influenced by the interdisciplinary nature of the research centers. I should think there would surely be specialists in the fields of motivation, perception, learning, attitude formation, and the like; that there would be specialists in the area of parent-child relationships and parent-teacher relationships; that there conceivably would be biologists interested in behavior genetics; that there would be specialists in group dynamics; that there would be teachers; and that there would be representatives from the administrative side of our schools. I suspect, too, that there would be architects since they play such an important role in the design of buildings where a climate is created for efficient learning.

(d) Is there a sufficient need that would justify the centers as an addition to the existing system of grants for projects in the areas of education, training, learning, and media research?

Again, it seems that we come back to the point that research on learning must be longitudinal. Short-range research -- research on a single, narrowly conceived project -- can be carried out very well by a university or a school system, but it is the long-range, longitudinal study that will add greatly to our knowledge of learning, and only a well staffed research center can conduct such projects efficiently.

(2) Scope of Research Programs

(a) What are the significant problems that could advantageously be investigated by such permanent centers? Please list a range of general problem areas accompanied by a brief descriptive paragraph about each area.

1. I could conceive of a research center as serving first as a kind of consumer's union, or a testing center on equipment to establish standards for various kinds of equipment much like the Government Bureau of Standards assesses claims for industrial products. A research center which could test a given item of equipment, or a proposed program of learning and make this information available, would provide an invaluable service to schools everywhere.

2. Learning of language. We know comparatively little for sure about the psychology of language, even of our native tongue. We need to study the learning of language at the pre-school, elementary, secondary, and college levels; we need to find the age at which language can be mastered the easiest; and we need to analyze methods of teaching language from a developmental standpoint. We also need to study the relationship between first learning to speak the language and then learning its formal structure versus the procedure, which is followed so often now in colleges, of first learning the structure of the language and then trying to speak it. In other words, we need a concerted attack on language learning and language teaching for our young people so they, as adults, will be able to converse easily with the people of the world.

3. Efforts should be made to broaden and improve creative thinking. We should be investigating flexibility in thinking and how flexibility or creativity is encouraged, and conversely, we need to know much more about the bigot: his personality structure, how he learns to remain inflexible, and how he takes a single biased approach in his thinking to social problems in the face of evidence to the contrary. This whole tendency to think in limited categories needs to be studied and suggestions offered to the classroom teacher as to how flexibility in thinking can be retained (or encouraged) in the child.

4. Group problem solving versus individual problem solving. Independent study, which is so often suggested, is fine but there is also need for cooperative problem solving with reinforcement coming from the group. We need to know much more about the combination of individuals in groups, the interaction between these individuals, and resultant problem solving. Here I am thinking of the kind of studies carried out on a limited scale by Alex Bavelas.

5. Reading. This is our nation's number one problem. How can we be sure that all children will learn to read efficiently and widely? This is a problem in the psychology of perception, learning, and motivation. It is very possible that the techniques we are now using are not the best for all children or we would not have so many retarded readers. We need to know more about the contribution of the home to reading and what parents can do in the pre-school years to facilitate the intellectual and perceptual growth of the child so that he is ready to read upon entering school.

6. A sixth area might be said to revolve around Bloom's *Taxonomy of Educational Objectives*. The transmission of information is a worthwhile educational objective, to be sure, but we also need to study the problems of generalization, especially concept formation, reasoning, and logic. All this, one might say, is in the direction of helping teachers teach children how to think, or, "learn to learn." We need to know much more about teacher behavior and teacher effectiveness: who is a good teacher, the climate in which reinforcement occurs, the classroom studied in terms of its group dynamics, the general morale of the youngsters in the classroom, and the social incentives for learning.

7. We need to know more about the amount of learning for which parents should be responsible. We need to know more about parent-school cooperation, the role of the parent in helping the child learn to read, and the role of the parent in reinforcing what the school is attempting to accomplish. We need television programs beamed to homes to help parents become better teachers.

8. We need to know more about how and at what time we kill the interest of children for learning. Children start out life with a tremendous enthusiasm for discovery and learning about the world. We need to know why some youngsters become increasingly disillusioned as we make the transition to book learning; we need to know why there are so many under achievers, and why there are so many drop outs in school. These questions probably reach into the very fabric of our society in general.

9. We need to know more about the design of the school curriculum for fostering learning. Our curriculum now is based pretty much upon tradition and upon expectations of parents rather than upon what children can really learn at any given age if the material is properly presented. We need to study, as is presently going on, new ways of teaching mathematics, and the physical and biological sciences. We need to extend our best teaching techniques into the social sciences, including psychology. I suspect that psychology could be taught to children in the first grade with a good deal of effectiveness. We are not teaching it now simply because we have not thought in terms of introducing psychology at a low level.

10. We need to know much more about teaching the slow learner and freeing the gifted learner. Automated teaching should be a boon to the mentally retarded. Surely 8mm. sound films that repeat over and over again have a place in the education of the slow learner. But who is producing such material now?

(b) At what educational levels should these centers work and with what emphasis: pre-school, elementary, secondary, college. All of these in each center, or should different centers specialize in different levels?

In my opinion, each center should be located in a geographical area with good population resources. This means that each center must have at its disposal pre-school, elementary, secondary, and college students so that it can work on any problem at all age and grade levels. A center should be able to begin with children at the pre-school level and follow them along until they became college students and older. Learning needs to be studied throughout the life span. Earlier, I probably should have mentioned the need to study learning from the standpoint of making the most of "leisure" time at all ages.

(c) What should be the proportionate emphasis on the basic-to-applied continuum of research on complex learning?

I do not think that basic and applied research can be separated. As we work on learning prototypes we will, by the very nature of things, get involved in applied problems as well. But, if one were forced to budget time into categories in order to get funds, I should think that a 50-50 split between applied and basic would be reasonable. We should realize, of course, that much of the applied always has basic elements in it.

(d) If several centers were to be established can you suggest ways in which they might be differentiated with respect to the kinds of problems each would attack?

I think the differentiation would be more in terms of personnel and local resources--resources around the center. There are, to my mind, no unique regional problems unless of course there are certain technical difficulties to be solved. Conceivably the use of educational television in a mountainous area would pose a problem that would not arise in the use of television in a plains area. This is not so much a matter of allocation of function to certain centers as it is the unique problems which might be encountered simply because of the geographical location of a center. Another example might be the study of children from rural or geographically isolated areas. Some parts of the country are better for such studies than others.

(3) Facilities and Instrumentation

(a) What kinds of buildings would be needed? How should they be financed? Is new construction necessary or could existing buildings be used?

The buildings need to be of a laboratory nature, they need to have cells for individual projects , classrooms with television monitoring cameras, classrooms equipped with the best in audio-visual facilities similar to those in the Command and General Staff School, and experimental classrooms with computer facilities similar to those at the Systems Development Corporation. It is possible that old buildings could be remodeled to provide these physical facilities but I suspect that special purpose buildings along the lines of the Primate Research Center would be needed.

It seems to me that the recent developments in team teaching call for rooms that are very flexible, not fixed, in design--rooms which can be increased or reduced in size depending upon the needs of the youngsters, with independent study cells that can be created as needed adjoining the larger classrooms, and where groups can work on their own and come back and report to the main body. I believe it would be difficult to provide these kinds of physical facilities in old buildings. New buildings need a modular design so that novel arrangements can be created within the building itself as needs of teaching and learning change.

(b) What kinds of instrumentation would be required? At what levels of detail should specifications be included in the general plans for the centers?

There should surely be closed-circuit television facilities available. These facilities should not only be available for teaching purposes but also for observing the activities within the classrooms and experimental cells. There should also be available open-circuit facilities so that programs can be broadcast directly to the community, thereby involving home, church, community, and school. Full facilities should be on hand for 8 mm. and 16 mm. movies, video-taping, rear projection, and the rest of the new media including a full complement of teaching machines. The rooms, as mentioned earlier, should be variable in size. We have the spectacle in many of our schools now of far more children occupying a room than the room was designed to accommodate. I could imagine studies being done on what happens when space shrinks around a class, or when a class is crowded into a limited space: what happens to discipline, group effort, gains in achievement? There is some research evidence that when children have crowded work space, achievement suffers. We might also inquire about tendencies toward illness and absenteeism as rooms become more congested. How well satisfied are children with their learning experiences in rooms with ample space versus limited space? These are critical problems awaiting full study.

(c) What other facilities would be necessary--e. g., access to subjects, information retrieval, data processing, etc., and how could some facilities be shared among the several centers?

The centers should be as complete as possible. It is better to concentrate resources in all the centers rather than scatter them from center to center. It is my opinion that we should think in terms of complete research centers rather than a network of half-equipped centers.

(4) Staffing, Organization and Administration

(a) What kinds of research personnel would be needed?

There surely should be specialists in learning theory, specialists in group dynamics, specialists in instrumentation, research design, and statistical theory, specialists in new media in education, and specialists in classroom teaching or outstanding teachers that could be selected.

(b) What size staff would be a minimum for launching a center?

Probably eight or ten interdisciplinary people with assistants, staffed much like the Primate Research Center.

(c) Are such personnel likely to be available?

Such personnel are likely to be available only if long range activity is assured.

(d) Should the centers be related to universities and based on campuses?

Centers should be related to universities only informally. The centers should be graduate centers, independent of any school system or university.

(e) To what extent can and should they be interdisciplinary?

The basic staff should be well trained research persons from all the behavioral sciences. Consultants -- i.e., architects, artists, biologists, educators, linguists, physical scientists -- should be engaged as needed. Some centers might require full time persons in some of these disciplines, depending on the nature of their research.

(f) What kinds of regional inter-university cooperation are likely to be both possible and desirable?

University staff members with research grants might utilize the resources of the research centers, but the centers themselves should be independent of local ties.

(g) How should the centers be administered?

The centers should be administered by an independent administrative unit with an advisory committee of scientists, legislators, public spirited citizens, and others interested in education.

(h) If there were several centers, how could their efforts be coordinated? By whom?

Each research center director should control the work of his own center without coordination imposed from above. Planning meetings and exchange of reports among all directors should be adequate to insure an orderly over-all program and prevent duplication of effort. As each new center is opened, perhaps directors of existing centers should have some word on the selection of the new director, in the hope that coordination can be maintained at a personal level in a professional, non-bureaucratic way. Social scientists should be able to operate responsibly in this way.

5. Location of Centers

(a) Could you state ten criteria for selecting the locations of the centers?

This is a hard item to answer. Obviously such a center needs to be near a supply of subjects, to cooperative universities, to open-circuit television facilities, and to demonstration centers of various kinds. Possibly the location of the center could be dependent upon the degree of assured cooperation on a state-wide or regional basis as well as on local cooperation. There must be an easy flow of traffic in and out of the center and there should be some degree of population diversity.

(b) How many centers should be established -- initially and ultimately -- and on what time schedule?

I think that there should be one complete prototype center at the outset with plans to establish other centers at three or four year intervals.

6. Financing of Centers

Financing should be as diverse as possible, both from government and private sources as well as from foundations. We should finance them completely, center by center, with enought guarantee that a center will have a life expectancy of at least a quarter of a century.

(d) What are your estimates of the likelihood of adequate, sustained support now and in the future?

If we can establish a Primate Research Center as we have in Portland, we surely can establish similar research centers for the study of learning if we are sufficiently resourceful in our appeals.

7. Summary Statements

Learning is the most important activity of man, yet there has been no long-range coordinated research program of study on how and why it occurs. Research by individuals and groups has revealed some of the conditions under which learning occurs, but there is fragmentation and lack of over-all continuity in what has been reported. If the resources of our people are to be developed fully, a systematic program of studies of learning at all ages is needed. These should cover subject matter, methods, environment, behavioral correlates, including attitudes and values, and biological correlates.

With a small portion of our people making great strides in power and space research, it seems necessary to plan for the highest educational development possible of all citizens in a democracy, both to support production of new vehicles and to use them wisely. The wisdom and understanding of people in a democratic society are necessary to the constructive use of the new power which physical scientists are making available. Basic research in learning can show the way to make the most of important national resources.

PLANS FOR ESTABLISHING REGIONAL LEARNING RESEARCH CENTERS

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I. Programmatic Orientation

A. Research centers with continuing financial support may have several advantages over individual research projects:

1. Centers provide constant opportunities for the interchange of ideas and of criticism, both of which are vital to sound, imaginative research.

2. Centers make it possible for several individials interested in the same general problems but with differing expertise to mount a joint attack on the problem.

3. Several individuals with close knowledge of each other's work are less likely to miss important new features of the research.

4. Centers may have facilities which enable new leads on research to be followed up more easily and more rapidly.

5. Facilities are available for joint use, thus saving on duplication of equipment, space, etc. Tool-up time for new research may be reduced.

6. Centers with continuing support have significant advantages in recruiting and holding personnel.

7. The inevitable administrative tasks may be reduced by some centralization of responsibility.

8. Regional research centers could help in the coordination of ongoing individual research projects relevant to their interests. Coordination is not used here in the sense of directing or imposing restrictions of any kind, but rather in the sense of providing opportunities for interdisciplinary exchanges of ideas and comments on problems of common interest.

B. Programmatic, sustained research also may have its problems:

1. Programs, once established, can be evaluated only after opportunity has been given to get well underway; thus, unproductive programs may continue for some time before their lack of success is documented.

2. Expert individuals cannot always be welded into productive groups; in such situations the center type of organization may actually reduce productivity. However, persons trained in the center's environment may acquire the skills and attitudes basic to interdisciplinary cooperation; in this case the payoff of the center as a cooperative enterprise may come with some lag after its establishment.

3. Poor organization and administration may interfere with productivity.

4. Emphasis of the center on cooperative research may interfere with individual imagination and initiative.

C. These problems can be solved and a center's productivity maximized:

1. There is no substitute for good people; therefore, careful selection of a center's personnel is vital. There are a number of well-known approaches to good selection; all include indices of sound training, skill in techniques, high level of knowledge, capability of generating new ideas, motivation, ability to think critically. These are not "boy scout laws," but may be based upon past productivity, peer judgments, etc.

2. Productivity may be facilitated by minimizing the amount of distraction from his primary research goals to which individual research workers are exposed, e.g., administrative duties, "interim" reports, visiting "firemen," etc.

3. Maximum freedom for each researcher to pursue his own ideas within the general framework of the center is an important motivating factor.

D. Centers could have the advantages listed earlier, in which case they would supplement and not overlap individual grants programs. There has been a tendency during recent years to place more emphasis on the research center concept in medical research, in research on atomic energy, etc. Centers have been established in various disciplines, including psychology and other behavioral sciences. It might be worthwhile to find out more about the operations of centers which have been successful.

II. Scope of Research Programs

A. There are two major determiners of problems appropriately investigated in the proposed education and learning research centers: (a) the relevant scientific knowledge and (b) the practical aims toward which this knowledge is to be applied. The aims with which we are presumably most directly concerned are those of education, with special reference to that part of education which takes place in schools but not necessarily limited to the education of children. There is relatively little scientific knowledge concerning the characteristics of human behavior and the processes of modifying it that is not applicable in this situation. The general scope of the research program, therefore, could include all of the areas of interest and research now represented in psychology departments and schools of education with possible additions from university departments of English, philosophy, radio, television, etc. which are concerned with problems of language and communication. Within this very broad area, however, one class of problems appears to be crucial. That is the application of available scientific knowledge to the aims of education as it is carried on in practical situations outside the laboratory. At the present time there is an unfortunate gap and lack of cooperation between the scientists concerned with learning and the educators concerned with teaching. This would seem to be the central area in which effort should first be concentrated. Interests peripheral to this central problem will (quite probably) develop soon enough.

Problems of this kind may be identified at the intersections of two classifications: (a) the processes identified in basic scientific research and (b) the situations identifiable in the practice of education. Some of the more important processes are listed below followed by a list of the more important situations.

Processes

1. Individual differences in learning. It is very clear that students differ in rates and upper limits of learning. Democracy

in education can only mean that all students should have opportunities to realize their full educational potentials. If the nation is not to waste its human resources, each student should be encouraged to progress as rapidly as possible to the limit of his capabilities. This means that we must have as complete information as possible about individual differences in rates and limits of learning. This must include knowledge of a developmental nature about rates and limits as a function of chronological age and about the relative importance of motivational and learning processes in affecting the plasticity of behavior patterns which are to be molded during a training period.

2. Methods for learning. It is a reasonable prediction that the research psychologist's major contributions to education will come from his knowledge of the learning process. Genetically determined factors affecting educability are certainly important, but the modifiability of behavior in directions of educational goals is dependent upon formal or incidental learning in the broadest meaning of that term.

   Psychologists have probably given more attention to research on the learning process than to research on any other general topic in their discipline. The very considerable information about the nature of the process and the critical conditions which affect it must now be translated into methods for increasing the efficiency of learning in the nation's formal educational systems. The methods now being taught to teachers are frequently based upon psychological research conducted in the first quarter of the century; much has been discovered since then about the shaping of behavior, about the selective strengthening of particular behavior patterns by differential reinforcement, about the process of "learning-to-learn," about the interference of new habits with old, and about other factors which are critical to the successful education of the student. There is much that is still not clearly understood. Systematic research could help greatly in translating present knowledge into methods for increasing the efficiency of teaching and of learning -- of both the teacher and the student -- in the educational system from the prenursery school to the university. Increased efficiency is essential if full advantage is to be taken of the nation's human talents and if the increasing demands are to be met for improving the quality and availability of education for all.

3. Motivation. There is much evidence that one of the major areas of problems in American education today is that of motivation. How can an individual's interests in learning be aroused and maintained? What are the most effective methods for selectively reinforcing the learning of those behavior patterns which constitute the goals of a training period? We must know much more about the critical factors which affect motivation in the school situation: about the relative effectiveness of aversive reinforcement, intrinsic vs. extrinsic rewards, and secondary rewards in the educational process; about the effectiveness of different schedules of reinforcement; about the process by which secondary motives are acquired. Basic research which would provide a systematic body of knowledge about such features of motivation should be supplemented by research directed toward developing and evaluating methods for applying the knowledge in the school environment.

4. Complex intellectual processes. Education involves much more than the learning of specific habits and detailed knowledge. Recent research has provided some "breakthroughs" in the study of more complex intellectual processes such as concept-formation, decision-making, information-processing, and the acquisition of attitudes, all of which are involved in the educational process as well as being among the major products. This new knowledge and the methods which have led to its discovery can very profitably be put to work in the educational situation. Some such application is already being made in experiments on methods for teaching in mathematics, physics and a few other content areas; the results are striking in terms of improvements in the general efficiency of learning. The research needs to be extended to all areas of formal education and special attention must be given to determining the limits within which the new methods are effective.

5. Transfer of training. It is obvious that effective education provides knowledge and skills which will transfer from the formal school situation to the occupational needs of an individual and to his behavior as a member of other social institutions. The kind, the amount and the critical conditions for transfer of training constitute some of the most fundamental and complex problems in education, yet at present there are no definitive answers to the many questions which these problems raise. It may indeed by the case that current methods and sequences of

teaching may actually produce negative transfer -- interference-- in the learning of various skills and knowledge. Research is badly needed on how to maximize the transfer values of formal education; this should include studies of methods of teaching for transfer of curricular content producing greatest positive transfer effects, of difference in effectiveness of transfer resulting from different methods of learning, and of the types of habits which will transfer best to later learning situations.

6. Social factors affecting educational achievement. The student is not an isolated learner. By school age he has become a member of several social groups which exert very considerable influences upon the level of his educational success. Research during recent years has illustrated the particularly important effects membership in such groups has upon his motivation and his personal adjustment to the school situation. Much more research is needed on the effects on rates and limits of learning of parent-student and teacher-student relations, of home and community environments, and of the school as a social situation.

Situations

1. Laboratory and practicum situations. These are situations or techniques that have developed more or less naturally for "teaching" material that can be learned but not taught: at least this material cannot be taught effectively by the lecture method alone; it requires practice individually or under guidance. The situations include those in which the teacher motivates the students to practice and selectively reinforces their performance. It excludes situations in which the student can (apparently) learn simply by listening to the teacher talk.

2. Lecture situations. This category includes the many situations in which the process of teaching seems to involve little more than the organization and presentation of material, orally or perhaps visually, thereby producing understanding or increasing knowledge. There is little doubt that this kind of teaching is not as simple as it seems, teachers do not in fact lecture to rational men whose behavior (or awareness) is independent of the laws of learning. But it seems to be the case that some ways of ordering and presenting materials in the lecture situation are more effective than others. There is need to examine this problem of ordering

and presentation scientifically to make it a technology based on transmissible scienfific knowledge rather than a pure art as it is at the present time.

3. Individual teaching and learning situations.

   These may include both of the above. They are utilized in practice primarily to enrich the program of the best students and to remedy the defects of others.

4. Retraining. The introduction of automation in industry has resulted in critical problems relating to the retraining of workers for jobs requiring new and quite different skills. We can stumble along guessing at the best means of accomplishing this essential retraining process or we can study the behavioral problems involved systematically with the objective of determining the optimal methods for accomplishing the task most effectively. It is very likely that retraining involves special problems in addition to those affecting initial learning.

5. Evaluation situations. These are the many situations in which it is necessary to measure the performance of individual students and groups of students, for research as well as practical purposes.

6. Aptitude determination, selection, and guidance situations.

   These are basically situations in which some future performance must be predicted from information available now, e. g., present performance, historical data, etc.

However, the research problems generated at the intersections of the process and the situation classifications may be supplemented by background studies of other kinds as these seem pertinent. A miscellany of these is listed below:

Miscellaneous Areas

1. General analyses of the educational process and aims. One of the first logical steps in attacking any area of research is to define the problems clearly. It is doubtful that psychology

can make its fullest contributions to education unless the behavioral processes involved in education are carefully analyzed in terms of pyschological variables and concepts. Methods for researching problems cannot be selected nor designed until the problems are clearly understood. This means that research psychologists must go into the classroom with the specific objective of observing the tasks faced by the teacher and the student. This is particularly important at the pre-college levels; it is not good enough for the psychologist to depend upon memories of his earlier experiences or upon what he believes "should" be the situation. It is also not sufficient to depend upon descriptions by even the best school psychologists, educators or teachers. The objective of the analysis should be to define problems researchable with psychological techniques. It should aim to describe in psychological terms the various behaviors desired at the end of a training period, the content of the training period, the nature of the learning process and of its sequential organization, etc.

2. Data relevant to major policy decisions in and about education. These are situations frequently faced by administrative educators and social leaders. It includes the necessity for making decisions concerning curricula in a broad sense, school systems and state and national educational programs at the legislative and executive level. The decisions themselves are not, of course, within the domain of research, but such decisions can be made more intelligently when they are based upon factual information than when they are not. In deciding, for example, whether to support technical schools or liberal arts colleges or in planning the optimum combination of the kinds of training provided by such institutions, it would be useful to know with some precision the biographical consequences, e. g., the social and technical effectiveness of individuals trained in various ways. There are scientific techniques for gathering such data and it is possible that some scientific knowledge is directly applicable. It is possible, therefore, that the research program we are considering could include investigations of a very broad scope very likely made in the field which could contribute data of considerable value to those who must make the policies that affect the field of education.

3. Instructional media, technical studies. The nature of instructional media affects the efficiency of communication

between teacher and student and, therefore, the efficiency of the learning process. The importance of research on the advantages and disadvantages of different media or combinations of media (e. g. , verbal presentation, textbooks, films, television) for the teaching of different content at various educational levels to students with wide individual differences has received considerable emphasis during recent years. There is still an obvious need for research to improve the use of existing media and to investigate the possibilities of developing new media. Particular attention should be given to research to determine the critical conditions which influence the effectiveness of the various media at different phases in the educational process.

It is perhaps obvious that each of the processes, situations and miscellaneous areas listed above can be broken down into much finer detail. For example, classroom, laboratory and remedial problems appear at all levels in the educational process and they may be further subdivided by subject matter. There are problems of teaching and learning reading, writing, arithmetic, science, languages, social sciences, humanities, etc. These are presumably sufficiently obvious that we need not go into further detail. The result, of course, is a tremendous matrix of potential problems for research. Within this matrix we would impose the single restriction that the research or research program should be concerned primarily with the application of scientific knowledge of processes and techniques to practical situations. This would exclude two types of research which are currently being carried on under other auspices. One of these is the basic research on psychological processes which is carried out independently of practical situational considerations. The other is the pure status research concerned with describing the present situation in local educational institutions (situations) in great detail but with no concern for the learning process. These two types of research are now well supported by departments of psychology and schools of education and should not be duplicated by centers concerned with research on the learning process in teaching situations.

B. Considering the tremendous number of possible research areas and problems remaining even after basic research and pure status research are eliminated, and the current relative scarcity of research concerned with the application of scientific knowledge of the learning process in educational situations (recent work on programmed learning is a notable exception), the possibility of duplication of effort is not likely to be a serious problem for some years after educational research centers are established. Further it is likely that excessive restrictions of research areas in the early stages of their establishment would be a handicap. For these reasons we would suggest that it would be unwise to arbitrarily limit centers to particular educational levels, problems, situations, etc. The problem of avoiding duplication and otherwise promoting an optimum coverage of the research area can be met later when these problems arise. One of the problems in establishing these centers will be that of manning them with interested and competent people. It would be desirable as far as possible to be able to take advantage of the current interests of people with these qualifications. The diversity of the interests of potential personnel are suggested by a partial list of relevant research now going on in separate departments of Indiana University. This list does not include any of the extensive basic research in learning in the Psychology Department or traditional research in education in the School of Education.

1. The study of the use of airborn educational TV to supplement standard public school curricula.

2. Audio-visual teaching aids development.

3. Language laboratory and other language training programs at the college level.

4. The programming of a textbook for use in the School of Business.

5. Programmed learning of the Russian language.

6. Programmed learning of maintenance skills for military personnel.

7. Programmed learning of elementary reading by retarded and normal children.

Almost any limitation on educational level, subject matter, technique or process would eliminate one or more of these activities from consideration by a center program. All of the persons carrying out these programs are potential staff members for a center on a full- or part-time basis.

C. It is quite likely that specialization in the work of particular centers will develop spontaneously along the interests of charter members and that necessary modifications can be accomplished by combinations of pressure and encouragement so that the final overall program will represent an optimum distribution of effort in the entire field. The technology based on the scientific knowledge of learning is a relatively new field. It is doubtful that anyone knows enough at the present time to specify in advance who should work on what problems and in what areas.

The immediate task is to encourage work in the area. This can be done by the establishment of centers with a relatively broad directive. At the same time a central committee, perhaps consisting of representatives of each of the centers, could be given the assignment of looking at the field as a whole and the research that the centers initially undertake. The comparison of the field and the effort would be the basis for recommending changes. Detailed and iron-clad planning at the start could be stifling.

D. The question of relative emphasis to be placed on basic and applied research has been discussed at some length above. In brief, our answer is that basic research conducted without regard for the problem of the educator, that is, without regard for the situation in which the processes examined are to be applied, should not be included. In addition investigation of the present status of the educational situation carried on without regard for the learning processes should be excluded. The emphasis should be placed on research on the learning processes in actual or practicable teaching situations.

E. We would like to suggest at least two kinds of centers distinguished by function. The first might be called evaluation centers; the second, teaching-learning process research centers. An Evaluation Center would be planned around an experimental school and should preferably be located in a city with a modern school system, such that cooperation in the research of the center could be obtained when necessary for final field tests. The chief purpose of this kind of center would be to evaluate special techniques at the most practical and realistic level, that is, in a normally operating classroom or school system. This work would be done in the actual operating school system after much preliminary testing on smaller scales elsewhere. The Evaluation Center could also have a second function of carrying out some of the earlier stages of research and development of particular techniques in the laboratory and in the laboratory school.

The primary function of the second type, the Process Research Center, would be the earlier stages of research and development. Their chief function would be to investigate and develop teaching techniques for particular situations, e. g., particular subject matters at particular educational levels, utilizing available scientific knowledge of behavior. They would not be concerned with the problem of adapting these techniques to any existing educational system. The results of this research might be adapted by incorporation into an existing system or it might well, if spectacularly successful, revolutionize the existing system. The function is development; final application is the function of the evaluation centers.

The facilities required for the development center would be far less; in particular the laboratory school would not be required. In what follows we shall suggest an organization and administration for centers adapted to developmental research. As far as we know no centers of this kind exist in any field of scientific endeavor. However most, if not all, of the necessary components have been tested on a small scale at Indiana University during the last 15 years. Members of the Psychology Department at Indiana University have functioned more or less informally to stimulate and provide technical support for the research of psychologists and members of related professions in colleges, extension centers, and other institutions within 250 miles of the university. This program was started primarily to encourage research by university faculty in the extension centers of Indiana University, which otherwise did not provide much stimulation facilities or technical support for research. In some cases the support was provided by university faculty members serving as research consultants in other institutions. In others the relationship was that of contractor to sub-contractor. Indiana University faculty members visited and corresponded with these members of other institutions, discussing, advising, and sometimes supervising their research. "Participating members" met irregularly on the University campus. Both teaching and research problems were discussed. In some cases those participating paid their own way and in other cases the university or research contracts contributed to travel and other expenses.

The overall effect was to produce research in places where ordinarily very little research is done. The reasons for the success of this enterprise are fairly obvious. In the region surrounding any major university there are a number of small institutions with service or teaching responsibilities which provide little stimulation, opportunity, or support for research. For various reasons, professional members of these institutions may lack confidence, technical ability, or interest in research. Interest based on mutual stimulation and technical ability is at its highest level on major university campuses but manpower and experimental subjects may be in short supply. It is common knowledge that the communities in which research-oriented unviersities are located are often "surveyed to death" and there is often a shortage of manpower capable of implementing all of the research ideas that develop in the university environment. The plan for the developmental research center described below is designed to take advantage of this complementary situation. The center provides support for research which is stimulated, directed, or supervised (whichever seem appropriate) by research leaders comprising a "board" at the center located on the campus of a major university. Much of the research is done outside the center by professional people in the surrounding regions with advice and supervision from the regional center. The research is supported by grants, but the center provides a service which grants do not, mainly stimulation, advice, and certain technical supports that are seldom available in small institutions.

The center would be built around five to ten or more highly qualified and interested professional people in various academic fields but concerned with learning, teaching and other educational problems. Most of them would be employed by the parent university with only part-time connection with the center. Possible functions of the Board are the following:

1. Attend Board meetings for planning and coordinating of various areas of research of the various areas represented.

2. Conduct their own research or direct their own research unit in their particular area supported by the center.

3. Advise, direct, coordinate related research being carried out on a part-time basis or in smaller projects at other institutions in the region. Some of this time would be concerned with giving talks aimed at developing interests and in making the contacts as necessary for public relations and obtaining subjects from the community, public schools, etc.

The director of the center might or might not be the Chairman of the Board, functioning on a full-time or part-time basis. He, together with the Board, would be responsible for the research policies and planning and instrumentation as indicated above. He should be supported by a full-time administrative assistant or executive director. The latter would be responsible for administrative coordination for outside and inside research projects. He would be responsible for secretarial and technical units which might include:

1. Administration, personnel, payroll, records, purchasing.

2. Secretarial, duplicating and distribution of reports, preparing final copies for publication, etc.

3. Computing, including statistical computations, coordination, and programming with the university computing center or possibly maintenance of a small computer on the premises.

4. Shop and maintenance, construction of research materials and apparatus.

5. Arranging for meetings on and off campus including lectures by board members in the surrounding region designed to stimulate research interests and to build the prestige of the center in order to facilitate in obtaining cooperation of school systems, etc. in the surrounding communities where research is being conducted.

III. Facilities and Instrumentation

Our suggestions for facilities in instrumentation will be restricted to the kind of center just described. This is the kind we would visualize for a region centering in Indiana University.

A. Buildings. Since much of the research conducted through this type of center would be done elsewhere, the major requirement is for administrative space. This would consist of offices for a full-time director, an administrative and secretarial staff, a computing staff, and a shop staff. There should also be provisions for periodic meetings of the operating research people with provisions such as one-way vision rooms for demonstration and some research. The meeting and demonstration rooms might be supplied by the parent university but the housing for administrative functions and a minimum of research space should not be dependent upon the university. Although it preferably "should be."

B. Instrumentation. Except for typewriters, calculators, and shop equipment in the administrative center I would prefer to think in terms of facilities for instruction and purchase of instruments. In my opinion much programmed learning research is currently greatly over-instrumented, the emphasis being on the machine rather than on the learning. Funds should be available for the purchase of small digital computers in case the need for them could be clearly demonstrated. In my opinion such devices at the present time impose unnecessary limitations on what can be done in programmed learning. It is much easier to program and change the program of a person using a simple device than it is to program or re-program a computer. Everything that a machine can do a person can ordinarily do and if the limitations of machine operations are kept in mind, the design of the machine can properly be left until last. At the present time all we need to know is what it is we want the machines to do. This is where the research should be concentrated. For the most part, therefore, the function of the center would be to make it easy for the research personnel to acquire well-built, but relatively simple, apparatus.

C. For the type of center I am considering the researchers themselves could ordinarily be expected to find their own experimental subjects. The center, however, would have a considerable public relations responsibility, providing providing prestige, information to the community concerning the aims and accomplishments of the organization, direct contact with school administrators, etc., specifically aimed at making it easy for the individual researcher to obtain what cooperation he needs from the school system or community.

IV. Staffing

A., B., C. The board and, therefore, the research conducted by such a center would presumably be interdisciplinary, the discipline represented being determined chiefly by the already demonstrated interest of those who might be recruited for the board.

D. The research and development center just described must obviously be placed on a university campus.

E. Several kinds of inter-university cooperation are indicated. The board of the center just described would work largely on a personal basis with research personnel at surrounding universities and colleges. The region in this case would essentially be a geographical region surrounding a major university at which the center was located.

However, there could be cooperation between several centers of the kind just described and an evaluation center. The evaluation center would be responsible for different kinds of research, e. g., the development of testing of classroom procedures that incorporated programmed learning, visual aids and curricula organization, in approximately the forms in which they might be used by a teacher. There could be cooperation between centers concerned with evaluation and those concerned with development of techniques but there could be no suggestion of dominance of one by the other. This means that there probably should be an overall research policy board possibly including public figures concerned with education, educators and directors of the various centers. This board would meet periodically and infrequently. Its function would be to plan, make policy decisions, evaluate progress and the general adequacy of the program.

F. Administration of the centers (already discussed).

G. Coordination of the efforts of several centers. Day-to-day coordination, gathering and distribution of information, etc. could be carried out by the full-time research administrator. Policy decisions affecting the research areas to be emphasized at all or at particular centers would be determined by the central board. There might well be a three to four day meeting each year of a) the boards of all centers and b) professional research staff with the aim of exchanging information and presenting the overall picture to all concerned.

V Criteria for Selecting Locations of Centers

A. Evaluation centers: a) in a large city, b) containing a university and c) a cooperative school system providing classrooms, teachers and pupils for evaluation purposes. Developmental research centers should be based at a) relatively large universities, b) with psychology departments, c) exhibiting considerable interest in learning and d) a school of education. The latter would not be necessary if the research were to concentrate, for example, on programmed learning of college level subjects. e) A demonstrated interest in teaching research and the development of new techniques would be necessary. f) An active audio-visual department would be required in at least one center.

B. I would suggest four centers for evaluation: one in the East, one in the Midwest, one in the West and one in the South. I would suggest four to ten dispersed research centers, possibly starting with four as soon as possible in places like Indiana where the situation seems to be ideal in terms of research now underway, the others to be established as seems desirable after three years in which the successes and failures of the first four should be apparent. Of the eight suggested, perhaps four could include centers for audio-visual development: two in the evaluation type and two in the dispersed research type.

VI. Summary Statements

Perhaps never before in history have there been more striking examples of the importance of education to human welfare and to national and international affairs than those which are clearly apparent today. Research and development by highly trained experts are leading to breakthroughs in the treatment of diseases, to the raising of standards of living, to increasing control of the physical environment, and even to steps into space. Education is playing a basic role in the success of newly independent nations in which democratic institutions of government depend upon an educated citizenry capable of accepting group responsibilities and of expressing its views wisely. Intellectual achievements have become features of foreign policy. Under such circumstances the nation must make full use of its human resources. This requires that all citizens be as skillful and knowledgeable as possible and that all be given opportunities to develop their educational potentials to the fullest extent of their capabilities. With these objectives in mind, nothing could be more remiss than to ignore the possibilities of improving our educational processes. Attempts toward improvement may be made by debate or by systematic study of the factors and conditions which affect educability. The research approach has characterized the nation's success in attacking other kinds of problems; it would indeed be strange if it were not the preferred approach in attempts to solve problems in education.

Among the problems in education in need of immediate attention are a number which center around the learner and the learning process. General problems of this kind have been subjected to a very considerable amount of research during recent years, but the research has been primarily oriented toward the controlled conditions of the laboratory and not toward students in educational environments. The need now is research aimed at application of the techniques, the knowledge of important variables, the basic concepts and principles to the practical problems of the realistic educational situation.

Applications of research know-how to the solution of educational problems are increasing, to a great extent due to recent increases in financial support of individual research projects. Experience with such individual projects suggests that it may now be time to consider seriously the advantages to our overall research effort of establishing research centers to supplement individual endeavors. A number of advantages are listed at the beginning of this paper.

The advantages are sufficiently impressive to warrant at least an empirical test of the research center concept in the context of educational research. The cost of such a test would not be great; the payoff in terms of advances in the efficacy of our educational processes might be.

RESOURCE PAPER ON THE PROPOSED ESTABLISHMENT OF REGIONAL LEARNING RESEARCH CENTERS

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Preface

The preparation of this resource paper was greatly aided by the counsel offered by the following faculty members of the University of California. Drawn from many departments and disciplines -- psychology, education, mathematics, English, sociology, electrical engineering, speech, business management, computer technology, child development, physics -- this group of individuals is a wide sampling of those scientists and scholars in the University whose research interests and current work are closely germane to the functions of the proposed regional learning research centers.

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This final draft of the resource paper is mine alone, and the colleagues named above -- though giving strong support to the main substance and intent of the paper -- are free of responsibility for any shortcomings in its detailed statement.

Richard S. Crutchfield

Justifications for Regional Centers

We are in a period of great ferment in research on human learning and its applications in the educational process. Fundamental advances are being made all along the learning frontier, ranging from breakthroughs in work on the biochemistry and neurology of the learning process, to new conceptions of complex verbal learning, to esoteric work in the computer simulation of cognition. A fresh spirit of innovation is sweeping the educational field, bringing basic redesigning of school curricula, active experimentation in the classroom, and widespread exploration of new educational media, for example the use of television and other audio-visual techniques, and the use of teaching machines, programmed textbooks, and related self-instructional devices.

To a greater degree than ever before, experts in a wide variety of disciplines and technologies are combining their research efforts in an attack on the problems of the learning and teaching processes. The time is extraordinarily auspicious for a much larger and more concerted attack on these problems. There is unprecedented opportunity in the next several decades to make research advances in this field that may have the widest possible implications for the role of education in our society. Radical advances in nuclear science and space engineering, and other industrial technological developments, have outstripped advances in the understanding of the educational process to a degree that strikes many as dangerous. Moreover, the world-wide population explosion, together with the revolutionary social ferment in the developing countries of the world, make the needs of mass educational resources vastly greater and more urgent than ever before. For it is only through the utilization of education that man can hope to control and constructively use these unprecedented physical and social forces which are being released.

Our society, and the world at large, can thus afford nothing less than a maximal effort in basic research and the application of its results to the field of human learning. Present efforts, promising as they are, fall far short of what is needed. The sheer amount of research support currently available is a tiny fraction of that required to exploit to the full the promising breakthroughs which have already been achieved. In many of the current research enterprises in the field there is inadequate provision for the development of comprehensive programs of research on fundamental problems. Long-term learning research programs are difficult to carry out now because of short-term financing and short-lived participation of the initiating researcher. Current investigators often have little cognizance of the ongoing work in other laboratories and in other disciplines, and there are often needless duplications of some aspects of research as well as large gaps in other aspects. There is a serious disjunction between research in the laboratory and application in the school setting.

The establishment of a number of regional learning research centers having clear programmatic orientation and generous budgetary support could contribute significantly to the remedy of these deficiencies. The prime purpose of such centers would be to accomplish ends that cannot be accomplished by existing projects and facilities.

(1) The centers would provide major physical facilities essential for the conducting of large-scale, highly complex, and long-range research for which adequate facilities are nowhere now in existence.

(2) Being planned around comprehensive programs of research, such centers would make possible a systematic attack on fundamental research questions having a scope and a continuity and requiring a mobilization of research resources far beyond the capability of single investigators or projects. Such programs of research can provide an over-all picture of progress in a field, showing where gaps exist and where promising leads lie. And they can provide a systematic framework facilitating the seeing of conceptual relationships between the findings from separate studies that otherwise may appear unconnected.

(3) Such centers would provide the stimulus and means for interdisciplinary work, drawing together the contributions of specialists in a wide variety of fields. Included would be not only experts in psychological research, but also scholars in various subject-matter areas, and specialists in the advanced technology of educational media. An auspicious climate would thus be established for the development of what is essentially a new discipline, centered on educational learning research, welded together out of what are now diverse fields. In this connection the centers would fulfill an indispensable research training function, both for students and for mature investigators.

(4) Such centers could provide a much-needed bridge between laboratory-centered research on the learning process and school-centered research on the educational applications. They would also help to bring about a much closer working relationship between those individuals concerned with the teaching and learning of specific subject

matters and the development of improved curriculum content, and those individuals concerned with the more general processes of learning and teaching.

(5) Such centers, being regional in character, would provide a means for inter-institutional research on learning problems of large scope. They would also make accessible much-needed research resources to individual investigators in the numerous and scattered smaller institutions within a region where it would not be feasible to duplicate extremely costly facilities.

(6) Less tangible, but no less significant, is the contribution such centers could make in instilling a sense of urgency about research on human learning that would help arouse the interest of many more of the most highly qualified and creative research experts drawn from neighboring disciplines, as well as from psychology and education, and thus enlist their participation in the research.

It is to be emphasized that the centers are not intended to replace or to inhibit the individual research projects that are now being carried on and must continue to be carried on. Such projects serve indispensable functions, and indeed would profit from greatly expanded support over present levels. They provide the essential safeguard for unique lines of inquiry, for contradictory points of view, for individual innovation. And these are values which no large and highly programmatic research center can hope to maintain in the optimal degree. The proposed learning research centers, therefore, are to be thought of as an essential complement to the already existing research activity by individuals and groups throughout the country.

Scope of Research Programs

In considering the possible scope of the research in such regional centers, the most important necessity is that of maintaining flexibility. It would be hazardous to pre-establish too firmly the specific nature of the detailed problems to be worked on. What is most essential is that such centers be so conceived and administered that maximum advantage could be taken of new ideas, of new developments in theory, data, and methods. The general scienfific objectives of such centers should be firmly established; the means of obtaining these objectives should be left flexible. In the broadest terms, these objectives are to come to an understanding of the basic processes of complex human learning, and to learn how this knowledge can be applied in making the educational system most effective in its endeavor to develop and nurture the fullest potentialities of the individual.

In achieving these aims, no possible avenue of attack should be arbitrarily precluded. Thus, for example, animal experimentation and neurophysiological research should not be ruled out in advance. This is not to argue that a center should feel obliged to be completely comprehensive in its research undertakings. Any attempt to give equal support to every possible line of inquiry would result in an unworkable dissipation of research resources. Rather, a given center should develop a strategy of attack which would marshal its resources optimally, concentrating heavily in some areas, and excluding completely in others. A center should especially concentrate on those problems which manifestly necessitate large-scale research enterprises and interdisciplinary cooperation. For it is just such problems that individual investigators and projects are currently unable to handle.

Similarly, no premature restrictive decision should be taken concerning the types and educational levels of persons to be used as subjects in the research. Any such major research center should certainly maintain its flexibility in this regard, being able to work anywhere from preschool level through adult level. Here again, the over-all research strategy of any one center might dictate the focusing of its prime energies on only one part of this spectrum.

There would seem to be obvious advantages to some form of coordination among the entire complement of such centers which would encourage prosecution of an over-all learning research program effectively covering all the main problems and approaches while avoiding needless duplication. For example, it is conceivable that each center might develop a distinctive major "theme" around which its primary work would be organized. (Several such possible themes are discussed later.)

The relative proportion of effort to be placed on "pure" research and on "applied" research in such centers is a difficult matter to decide. Perhaps the issue might best be solved by avoiding the dichotomy and by stressing the need for basic research carried out in the educational setting. There has been far too little such research possible up to this time. Much of the basic research that now goes on is limited to a special laboratory setting, far removed from the actual educational scene. This is often due to limitations in available resources. A unique contribution of the proposed learning research centers could be to make basic research feasible on a large scale directly within "real-life" learning situations, e. g., in the school. Moreover, it would be possible for such centers to establish highly controlled learning environments, perhaps in the fairly modest form of experimental classrooms, and perhaps in the much more ambitious form of experimental schools. Under these circumstances, some of the usual distinctions between "pure" and "applied" research would disappear.

Bearing in mind the foregoing considerations, some indication of the general range of research problems that a learning research center might undertake to study can be attempted. Within each of the following main domains of research emphasis a great many specific research questions could be formulated:

Study of the basic processes of learning and memory: Acquisition and reinforcement, retention, transfer, interference, etc.

Study of motivational and emotional factors in the learning process: Rewards and punishments as incentives, drive, the role of attention, curiosity arousal, achievement and competence motives, effects of anxiety and stress, etc.

Study of the developmental nature of the learning process: Age differences in learning process and capacity, development of skills, sequential growth of concepts, etc.

Study of individual differences in the learning process and in the patterns of performance: Personality factors, cognitive "styles", role of abilities and intelligence, determination of the limits of learning capacities, etc.

A variety of research topics having to do with different kinds and products of learning, and with different approaches to the study of learning, can also be listed:

Study of the nature of and training in verbal skills, perceptual discrimination, concept formation and attainment; logical and critical thinking, problem-solving strategies and heuristics; creative thinking; etc.

Study of the role of language and meaning in the learning process: Verbal mediation in associations, concept attainment, problem solving, creative thinking, etc.

Study of learning and training of attitudes and values, including the learning of social norms and roles, the formation and change of prejudices and preferences, the development of attitudes toward learning, training for independent-mindedness, etc.

Study of environmental control of the learning process: Stimulus patterning; effects of sensory deprivation and enrichment; etc.

Study of the information-processing activity underlying learning, problem solving, and creative thinking; computer simulation of learning experiments, involving validation or revision of computer "models" of learning by comparing outcomes of simulated experiments with data from actual human learning experiments.

Finally, a number of crucial research areas having to do with the efficient utilization of various learning and teaching media and methods can be mentioned:

Study of audiovisual methods in learning and teaching, both as supplements to, and substitutes for, lecture methods; research on use of television, "language laboratory" techniques, etc.

Study of self-instructional devices in programmed learning; research on use of teaching machines, programmed textbooks, etc.

Study of computer-based classrooms and other related methods of far-reaching environmental control and manipulation of the learning-teaching process.

Study of the effectiveness of combined use of the various main types of teaching-learning media in an integrated instructional program.

Study of the development and use of special instructional media, automated programs, group learning techniques, etc., for the education of educationally handicapped children -- the deaf, blind, retarded, neurologically handicapped, etc.

Study of teacher behavior in the classroom and its effects on student learning; role of the teacher as monitor, diagnostician, remediator, etc., in the instructional process.

Study of the experimental use in the classroom of newly designed curriculum materials, with appraisal of effects on short-term and long-term learning.

As noted earlier, it might be desirable for each center to organize its thinking and work around a small number of major "themes", each theme being rich enough to include a large range of specific problems. To illustrate: One such major programmatic theme might be that of individual differences in learning; another major theme might be developmental aspects of learning. Such themes, then, could be thought of as representing different main lines of attack on, or different conceptualizations of, the total problem of human learning. Thus, the various centers around the country would be simultaneously at work on the same principal objective but from many different perspectives. While not arbitrarily constraining any one center from pursuing its research as it deems necessary, this might serve beneficially to give a distinctive emphasis to its program of work.

Facilities and Instrumentation

Ideally, the centers would require the construction of new and specially designed buildings. Existing buildings are not likely to be available, or to be readily adaptable for optimal research utilization. A variety of specially equipped laboratories, possessing unusual technical features, would be indispensable. Space should be so planned as to make for easy and rational expansion of facilities as required by future growth.

The kinds of instrumentation needed would be highly diverse and expensive. Detailed specifications cannot be given here, but certain general categories of requirements can be indicated:

(1) Instruments would be needed to make possible the controlled presentation of highly complex stimulus displays in different sensory modalities. Both individual and group stimulus displays would be required. Moreover, instruments would be needed to make possible the study of a great variety of response modalities.

(2) Highly sophisticated instrumentation for data recording and primary processing would be required, so designed as to make for efficient and economical research operations. Such instrumentation should reflect the most recent innovations in data-processing methods.

(3) Each center would require its own, or ready access to, high-speed electronic computer facilities. In addition to the more conventional use of such computers for extremely complex data processing and statistical calculations, it might be desirable to design and install high-speed computers quite unlike the standard ones now available. The need for computers so constructed that simulation of learning and cognitive processes could be carried out most effectively should be particularly considered.

(4) Provision should be made for the study of behavior in highly controlled learning environments, where the scope of stimulus control far transcends that now available in the usual laboratory situation. One specific form that this might take would be the automated, computer-based classroom. But it would be desirable to extend this concept to wider limits so as to make possible the computer-control of larger chunks of learning behavior over longer periods of time.

(5) Extensive facilities would be required for research in various audiovisual media, including television, sound-recording, and various specially designed systems, e. g. , language-teaching systems, etc.

(6) Extensive provision should be made for research utilization of various new auto-instructional devices, the so-called teaching machines.

(7) Were the centers to plan to extend their research investigations into use of animal subjects and neurological techniques, the usual kinds of animal and physiological laboratory facilities would, of course, have to be provided.

(8) In connection with all of the above, the centers would need to be provided with their own, or access to, shop facilities and mechanicians for work on apparatus.

In addition, of course, to the various physical facilities outlined above, there would be the crucial need for large and varied populations of subjects for experimentation. Some of the subjects would need to be brought to the center itself; others could be studied within the schools. In order to facilitate such experimental research and testing in the schools, there might be needs for construction of mobile laboratory units which could be used for efficient and economical in-school research.

Staffing, Organization, and Administration

Staffing of the proposed centers is one of the most crucial of all problems to be faced. The success or failure of such centers will rest primarily upon success in attracting scientific research talent of the highest quality. The individuals must be chosen to represent a wide variety of disciplines and approaches. They need not, indeed should not, all be "orthodox" experts in the field; considerable latitude should be left for the appointment of "off-beat" research workers, or ones drawn from unusual research backgrounds, who might produce important innovations in theory and method.

Such high-caliber research personnel could only be obtained if the centers were able to be made maximally attractive to them. Availability of excellent research resources, reasonable freedom to pursue one's research interests, appropriate salary, and the like, are all positive inducements. In addition it is important that the senior staff be able to have the status accompanying some form of continuing academic identification. This could most easily be provided by having the center closely tied in with a university.

It is important to re-emphasize that the centers should be interdisciplinary in character and, of course, in staffing, Clearly, psychologists and educational researchers would constitute the staff core, but workers in many related disciplines should also be well represented. These might include, for example, mathematicians, sociologists, engineers, philosophers, etc., as well as scholars in the sciences and humanities especially concerned with educational problems in their respective subject-matter areas.

It perhaps goes without saying that specially qualified school teachers would be brought to the centers on temporary staff appointments in order to collaborate on some aspects of the research. In this way the two-way bridge between laboratory and school would be further reinforced.

In addition to the principal research workers already mentioned, there would, of course, be the usual need for a large contingent of "support" personnel -- technical, clerical, etc., -- as permanent part of the staff.

Training. Any viable research enterprise must include a research training function. Such centers should therefore be planned and organized in such a way as to give full scope to this training function. Thus, part of the staffing of a center would consist of several levels of trainees: (1) especially selected graduate students from a variety of departments; (2) post-doctoral fellows of junior level; (3) senior fellows, who are mature individuals wishing to get special training in some of the complex areas of research envisaged for these centers.

At all of these levels emphasis should be put on the selection and training of individuals representing a variety of disciplines, with an aim of gradual cultivation of a "new" discipline centered on educational learning research.

The specific nature of the training to be provided would of course vary widely, depending upon the level of the individual and on the particular kinds of research in progress. In any case, such individuals would be working directly on research projects, either under the supervision of senior staff members on on their own. An indispensable activity of such a center would be regular staff colloquia for the discussion of research.

Regional organization. The centers, as regional centers, should of course be so organized as to maximize inter-institutional cooperation. Thus the center would be a means whereby research activities in many institutions throughout the region could be mutually stimulated and strenghtened.

Making the proposed research centers regional in character raises a number of obvious problems. The most important of these is the means by which a center, located in one place -- presumably in or adjacent to a major university -- can be made maximally useful as a resource to individuals in other institutions within the region. As one step in solving this problem it would seem desirable that such inter-institutional arrangements be basically "built in" beforehand to the plan of the centers. This might take the form of explicit earmarking of specific laboratory and other facilities for the use of institutions in the region, the provision of staff fellowships or other research appointments set aside for individuals in such institutions, the establishment of exchange training for graduate students among the various institutions and the center, the planning of joint research conferences at the center for the various participating institutions, etc.

It might also be considered desirable under some circumstances to set up research "stations" of the center in some of the regional institutions. These obviously could not be equipped on a scale comparable to that of the center itself, but could provide necessary facilities within those institutions to make possible their participation in major research programs of the center, the work for which could be conducted in their own institutional settings.

An especially ticklish problem arises in conjunction with regional cooperation between two closely neighboring major institutions, in each of which a large complement of research workers and research projects in learning is already established. If a regional center were to be placed wholly in one of these major universities, it is not likely that the center would be optimally used by those in the other major institutions nearby, despite the physical proximity. In light of this "fact of life", it would be desirable to consider the feasibility of setting up large research "stations" of the regional center in both of these major institutions. With appropriate planning, facilities could be constructed for these stations which would not wastefully duplicate one another. As a concrete example, assuming that a regional research center were to be established in the San Francisco Bay Area, presumably either at the University of California or at Stanford University, there would be great merit in the setting up of non-overlapping facilities at both places (such as has been done in the case of the cyclotron and the linear accelerator). In this manner there would be encouraged optimal utilization within each institution of its extensive resources of scientists and projects, and at the same time an incentive would be given for close cooperative work between these major institutions.

Administration. Each center should be administered by a Director, an individual of highest scientific and research competence, possessing a broad outlook on the field. There should also be an Advisory Board which would give counsel concerning the activities of the center. The Board should be so constituted as to reflect different disciplines and to represent different institutions within the region.

To whatever degree desired, the work of each center could be coordinated with the work of the other regional centers through a standing committee made up of the Directors of the various centers, some members of the Advisory Boards, and other highly qualified scientists. Through this means there could be achieved a constant exchange of research information, a joint planning of certain major research enterprises of interest to, and requiring the work of, more than a single center, an arrangement for exchange of research personnel among the centers, the planning for maximal joint utilization of technical facilities of the various centers, etc.

Criteria for Location of Centers

In deciding where such proposed centers should optimally be located, a number of criteria would seem relevant:

(1) Regional spread. The centers should be distributed geographically so as to give a representation to each main region of the United States and at the same time to capitalize on the already existing concentrations of learning research and related activities throughout the country.

(2) Centrality in region. Within each region the center should be strategically placed in such a central geographic way so as to make it maximally available to different institutions within that region.

(3) Proximity to metropolitan area. The center should be set up in reasonable proximity to a major metropolitan area, possessing the intellectual and cultural attributes which would make it highly attractive to staff members of the center.

(4) Access to subjects. For the purposes of its research investigations, the center will need access to an ample supply of subjects of diverse characteristics, including school children, high school and college students, and adults, and also including special populations, e. g., the handicapped.

(5) Access to schools. It would be essential for the center to be located near to a number of school systems which are ready to cooperate in research experimentation, and which are highly heterogeneous with respect to ethnic makeup, socio-economic levels, types of educational problems, etc.

(6) Access to technical facilities. The center should be located where various kinds of technical facilities will be readily available, such as libraries, engineering shops, computer facilities beyond those in the center itself, etc.

(7) Proximity to research activities. In order to maximize the effectiveness of its own research, the center should be strategically near to other relevant ongoing research enterprises, both academic and otherwise.

(8) Connection with university. The center should be connected with a major university, either being an integral part of the university or having a close working relationship with it. The center should be located on or adjacent to the campus.

The reasons for this are many and compelling. The intellectual climate of a university is a highly desirable one for a research center. The university can provide for easy consultation with technical experts in a great variety of special fields. It can provide access to various needed facilities, e.g., libraries, engineering shops, university presses, etc. It can give access to populations of student subjects and courses for experimentation. It can supply graduate students for training and work in the center. It contains many kinds of research enterprises having relevance for the work of the center.

And, above all, the university can help provide the senior scientific talent needed for the staffing of the center. Such top-level research talent is in very short supply; most of it is to be found in university departments. It is unlikely that many of those first-rate researchers would leave the academic environment and give up their valued academic identifications to join a center which was not located in close relation to a university.

Financing of Centers

The most crucial point regarding the financial support of such regional centers is the imperative need for long-range support, guaranteed for an initial period of perhaps ten years. There are three principal reasons: (1) The need for the carrying out of long-range programmatic studies, necessarily stretching over a period of years and requiring assured financial resources for the duration of the studies. (2) The need for setting up of large and expensive physical installations, which could only be justified for long-continuing research. (3) The need to be able to assure senior staff members of appointments of reasonably long tenure.

Inasmuch as considerable preliminary effort would be required for the drawing up of operating plans for a center, for the recruitment of staff, and for the other preparatory arrangements in the establishment of a center, it might be desirable that a preliminary grant of at least $100,000 be made available for the carrying out of these planning stages of development of that center.

During the first several years of operation the amount of financial support needed would gradually rise, reaching a full operating level within three to five years. Beyond that point, further increases would be dictated by the particular needs for extension of the program of research judged in light of the achievements of the work up to that time. There would, of course, be heavy initial expenses in connection with the construction and equipping of the physical plant of the center.

The total ultimate level of financial support probably needed for such a regional center is exceedingly hard to estimate. Certainly, even for the minimal level of operation consistent with the nature and size of an effective regional center, the operating budget would have to be more than one million dollars a year. And it is highly likely that the requirements would far exceed this level.

The needed level of support is large compared with the present meager level of funding for such research, but the needed support is modest when viewed in light of the vital contribution that the proposed research on human learning and educational process can make to the welfare of our society.

APPENDIX:

The Appropriateness of the University of California as the Location of a Regional Learning Research Center

Considering the reasons for the establishment of regional learning research centers, their proposed scope and mode of operation, and the criteria for their location, it appears that the University of California at Berkeley would be a highly appropriate place for the establishment of one such center. The center could either be located on the campus as an integral part of the University, or be located on or near to the campus in some form of close working relationship with the University.

First, as to meeting the previously stated criteria for location of a center: Assuming that there would be a number of such regional centers spread throughout the United States, it is obvious that at least one should be established on the West Coast. Within this region, Berkeley occupies a strategically central geographical location. Moreover, Berkeley and San Francisco possess the kind of intellectual and cultural climate that would be highly attractive to prospective staff members of the center. Located in or near to the University of California, the center would be assured access to the kinds of rich resources of the University needed for the center's research -- libraries and technical facilities, populations of subjects, graduate students, expert consultation, potential staff members, ongoing research enterprises in the University bearing on the work of the center.

It should be noted that the University has long taken an active and nationally recognized role in the encouragement and fostering of work in complex human learning and in closely related areas. There already exist on the campus a number of research enterprises which could form nuclei for a major learning research center.

Particularly in this connection should be mentioned the recently established Center for Human Learning, which is an inter-disciplinary enterprise concerned with basic research on numerous aspects of the learning process. Clearly the Center for Human Learning would constitute one of the principal core parts of such a regional center, or, were the regional center to be outside the University, would constitute an extremely important link between the regional center and the University.

The Institute of Personality Assessment and Research is another major research unit on the campus, much of whose work on individual differences in effective intellectual functioning would bear intimate relation to the research aims of a regional center. Especially relevant, for example, would be its current program of research on the use of programmed learning techniques for the facilitation of problem solving and creative thinking. Other research units on the campus relevant in this connection include the Institute of Human Development; the Child Study Center, which provides access to the study of nursery school children; the Language Laboratory; the Teacher Education Demonstration Center; the Center for the Study of Higher Education; the Elementary School Science Project; the Test Center for Elementary School Science and Mathematics; and the Computer Center. In addition, there are numerous individual projects currently in progress including work on the computer simulation of cognitive processes, the use of television and auto-instructional devices in teaching, studies of neurological and biochemical bases of learning, etc. The work of these various units and individual investigators in the University has established the University as one of the major places in the country where important research on learning is taking place. (The presence on the Berkeley campus of the editorial office of the Journal of Verbal Learning and Verbal Behavior, a major research organ in the field, is another evidence of this activity.)

The establishment of one of the proposed regional research centers on the campus would permit its capitalization on the work of these many already active investigators and projects. And such a center would play a significant reciprocal role in providing a research facility around which these now diverse and too little connected research activities on the campus could be polarized and mutually stimulated and advanced. The strong interest in research cooperation which many of these individual investigators expressed when consulted about the possibility of establishing such regional centers is a clear sign of the potential value to be gained from the presence of such a center at the University.

One of the crucial requirements for a learning research center is the availability of large and heterogeneous samples of subjects for experimentation. Berkeley and the surrounding communities offer an excellent supply of such subjects, representing widely different ethnic and socio-economic backgrounds. The public schools warmly welcome experimentation, and various research projects of the University are currently working extensively in the schools.

The disciplines of psychology and education would obviously provide the core for the work of regional learning research centers. In this connection it is noteworthy that this year a large new Education-Psychology building is being completed on the Berkeley campus, and this promises to promote an even closer and more effective research relationship between these two fields of work in the University.

The University has long been known for its important contributions to the natural sciences. The Regents of the University have recently approved the establishment of a four-million-dollar Hall of Science, to be built on the campus, which is to serve as a research center for science education with the aim of improving the instructional capabilities of science teachers at the high school and college levels. It is obvious that the activities of this new enterprise would fit in admirably with the objectives of a regional learning research center.

The University of California has had long and successful experience in the administering of major research centers with heavy federal financing. The Lawrence Radiation Laboratory -- the world-famed nuclear research center situated "on the hill" on the Berkeley campus -- is an excellent case in point. The administrative know-how gained over the years from the extremely large financing, staffing, and physical expansion of the Radiation Laboratory would be invaluable in solving the problems of administration of a new learning research center on the campus. It would seem highly appropriate, both symbolically and otherwise, for a major learning research center with its aims of furthering the educational progress of mankind, to be situated also "on the hill."

There are many flexible possibilities in mode of establishment of such a major research center within, or adjacent to, the University. An example of another type -- a center established on campus but not integrally part of the University -- is the newly-planned, federally-supported oceanography research laboratory soon to be built on the San Diego campus of the University.

It is particularly significant in light of the function of such proposed regional research centers in serving an inter-institutional role for an entire region, that the University of California, through its network of campuses throughout the state, already provides an instrumentality for cooperation in major research activities. Thus a regional center located at Berkeley would be in a strategic position to stimulate cooperative learning research on the various campuses of the University. Furthermore, it is of equal significance that the entire system of 16 state colleges is now coming into closer working relationship with the University, for example in the joint planning of graduate training in the state colleges. Again, the implication is that a regional center at Berkeley would be in a strategic position to serve as a source of research stimulation and an agent of programmatic research activity in human learning in the various state colleges.

On all these many counts there would seem, then, to be compelling arguments for the establishment of such a regional learning research center in or adjacent to the University of California at Berkeley.

NOTES FOR A RESOURCE PAPER --- PROPOSALS FOR ESTABLISHING REGIONAL LEARNING-MEDIA RESEARCH CENTERS

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This paper is offered in an unpolished form. It is hoped that the perspective presented will be of some help in developing large scale proposals for regional research centers across the country.

The proposals contained in this paper come from a context of crisis and mounting difficulty so characteristic of the urban educational scene. The crisis is an economic crisis which calls for an immediate consideration of human and technological productivity even though these considerations have been lacking in most designs for educational institutions.

The nature of the crisis, the availability of an information handling technology, and the theoretical interests of some educators all point to the timeliness of proposals for extended programs of research dealing with learning and the means for learning which might be charted as long-term purposes for regional learning-media research centers.

1. Justifications

The increasing public demands on education at all levels indicate a need for attention to problems of efficiency and change in our educational systems. The profession will require better theories of educational productivity that encompass both the quantitative and the qualitative. Clearly, present research efforts have not been closely tied to an analysis of qualities of learning as related to the broad-range, economic aspects of institutions of learning.

Research proposals should be set to go beyond the limitations of our present institutional frameworks for education. Among the major advantages offered by the information handling media are those which will allow changes in present institutional forms. We should study the problems of learning in the new frameworks we invent rather than in the old environments of present types of classrooms and institutionally structured situations.

Different kinds and qualities of education are required in the urban areas of our nation. Rehabilitation and retraining of human beings must accompany the rebuilding of the inner core of our large cities. In this rebuilding and retraining program we cannot avoid coming to terms with the arguments concerning education as a change-producer in our culture. Our culture is now consigning the uneducated and the untrained to the human scrap-heap. This we cannot afford. If present educational procedures cannot educate the broad ranges of our population, we must ask for new efforts of invention and new developments of institutions.

The "learning-media" research proposals must be placed in the context of these professional and cultural problems. The breadth and depth of the problems offer the best justification for an extended programmatic approach to research. None of the problems will be susceptible to short-range solutions. It is difficult to even begin to map the complexities we will encounter as intensive research proceeds.

2. Scope of Research Programs

A. Significant Problems

(1) For all our experimental programs in education, we need adequate measures of quality of individual learning. These measures of quality are crucial if we are to go beyond the use of large-group data in dealing with problems of individual learning. These measures of quality are lacking in research that has been done with conventional modes of teaching. At present, we cannot clearly relate qualities of individual learning to either tactics of media presentation or strategies in interpersonal activities with students by teachers.

(2) Most research dealing with media in learning has concentrated on the technical transmission facility rather than upon unique contributions or use of the media. We have used instructional television to transmit only the image of a teacher as we imagine he operates within the classroom. We have not taken advantage of media in the unique things it can transmit for educational purposes. Research clearly should go to a depth in media strategy far beyond what now is known and practiced among media producers.

(3) We also should investigate the unique needs or operations of the interactive teacher-student situation. Clearly, the man-machine systems of education in the future will require different forms of interactive situations between students and teachers. We need not structure our whole educational system on the basis of traditional classroom building blocks. We should investigate interactive possibilities in new institutional frameworks which technology might allow us to invent for the schools.

(4) All possible efforts should be made to keep the basic research in human learning going. The applied technicians and theoretical psychologists must work together in the design of educational situations that test and develop theory. Media related research should continue to be instrumental in helping theoreticians enter the realms of the human environment.

(5) Research in the learning-media centers should deal with the strategies or tactics of developing a changing profession. A good deal of professional time and energy is wasted in fighting misunderstood change. Research dealing with the possibilities of education "open" personalities is a crucial basis for programs in teacher education.

(6) Research on the problems of metropolitan areas should be designed to deal with the issue of the school as one of the agencies of change in the social order. All possible ways of cooperation and working with the authorities dealing with urban redevelopment should be established. Industry and other agencies in the urban areas may be of great assistance in providing resources and personnel to help the schools develop the man-machine systems for the future.

(7) One of the basic ways to look at the educational process might be to consider the information handling aspects only. Of course, education is more than the handling of information; but, the handling of information has been the traditionally imposed purpose of education through historical times. It is easy to assert that present-day technology gives us a technology of information handling. What kinds of new educational institutions can we design because of this facility?

(8) Among the areas of needed research that have always been too expensive except for limited project activity have been the continual relationship between tactics of media production and the subsequent learning by individuals. The exact nature of individual learning as related to tactics or procedures used in a media program has yet to be studied in any great detail in the environment and context of public education. We are far from having any generalized grammar or rhetoric of the film or of instructional television or of the audio-recorded media.

(9) One of the facilities offered by use of recently developed media for handling information is the possibility of changing activities from the large group environment of the classroom to others such as the home or relatively isolated individual learning centers at school. A student's homework might very well, in the future, consist of watching certain television programs. A student's work in school might be confined only to those activities in which interpersonal relationships with others, teachers and students, are clearly required for the desired learning. Self-instruction by students through use of materials may be a major characteristic of education in the years ahead.

(10) Some of the reasons students have been handled as masses rather than as individuals should be examined. Economic conceptions of the teaching-learning process may be one factor. It seems, however, that education has usually been conceived as an activity in which teachers always must be involved as mediators. We have not been willing to select or specify certain functions for consideration as items to be learned by individuals as differentiated from items to be learned in the social context of the school as mediated by teachers.

(11) The tools of research influence the nature of the program development. In this sense, the nature of the evaluation instruments such as standardized tests available for checking quality of learning has determined in large part, the nature of research dealing with the quality of learning. In the same sense, psychologists who would study the educational effect of classroom situations are limited by the facilities for recording and interpreting data gathered in these complex, environmental situations. Some new flexibility may be achieved through use of video-tape recording for capturing

classroom data with a minimum of interference. A video tape record may have great promise as a research tool. Slow motion video tape was used during the 1961 football season on some of the major networks. Perhaps fast motion video tape may be developed in the same rationale. This would allow the projection or viewing of many minutes or many hours of video tape materials in a compressed time period. At the present time, this compression of data can be partially achieved through use of conventional motion picture time-lapse photography. However, the use of motion picture technique limits the flexibility of camera in the classroom. The recording of good quality sound in complex classroom environments is still not solved as easily as the recording of the pictorial material. The creation of units of data measurement of audio-visual recorded data has yet to be refined to the level of units available to print.

B. What Educational Level for Research Programs?

Particularly for programs of research concentrated in urban areas, the research program should encompass all educational levels including the pre-school, elementary, secondary, college and particularly the adult educational levels. In addition to these, the particular problems of retraining displaced workers for useful social roles should be included whether or not it is now considered part of the adult education program.

C. Basic-To-Applied Continuum of Research -- How Much Emphasis?

In so far as possible the full range of the continuum from basic to applied should be included in a research center's operation. Present hunches about the learning process indicate that it will be necessary to continue a basic research program closely related to work at the applied level.

3. Facilities and Instrumentation

For many of the research aspects of these centers, either present buildings or buildings like those built presently could be used. However, if research leads to testing of applications of research in learning and research about media in school environments; we may need to produce new schools unlike any previously built. For example, if we seek to change from the institutional building block of the classroom into some other structure, we would need to build these new structures. Our present school buildings are more or less limited to a classroom kind of organization of instruction and teaching. We may be reasonably certain that more space and facilities will be devoted to individual inquiry and individual search for information. We may also be reasonably certain that increases in electronification both of presentation of information and storage and retrieval of educational data will become integral parts of schools of tomorrow.

Due to recent interests of psychologists, it is quite possible that we should develop classroom situations designed for research purposes. These research centers for classroom study would be developed so that the interactions and psychological effects of instruction could be studied in a way never before possible. For example, the video tape recorder allows us to record classroom data that may have gone unnoticed by previous in-classroom observers. The data recorded by video tape recorders are available for constant recategorization and study by research teams at later dates. The classification of data does not need to be done at the time of the event.

In general, specifications for instrumentation and equipping of the research centers should be delayed until a preliminary organization of the centers has been allowed to develop. Too great an investment at an early stage will commit the research center to a program of research utilizing the kinds of facilities that happen to be available, or are in vogue.

Among the facilities that might be planned for an early stage in the research center development might be electronic facilities for adequate recording, storage, and retrieval of information. It might be prudent to link the several centers together by some such system as Bell Telephone's Data Phone. In fact, the centers might be co-ordinated or at least related from a central point through this Data Phone System.

4. Staffing, Organization and Administration

At this time, it does not seem practical that a particular administrative pattern for the centers be proposed. In some cases the centers may well be administered by an independent agency within a college or university in the area. These situations should be selected on the basis that the results of research will be adopted rather rapidly into a changing program within the educational institution. These centers should be engaged primarily in investigation of applications of new theoretical knowledge to practical procedures.

One of the frontiers that these centers should perhaps explore is a new relationship between teaching and research that might be projected for the future. Though most doctoral degrees are reputed to be research degrees, few graduate students are really equipped for research effort. Most of them spend their remaining professional life as teachers with little effort directed toward research. Those who do research often proceed on the basis of what one man can do with meager facilities. The research-learning media centers could investigate the provision of facilities for active teachers to encourage part-time, partially financed research. This proposal is programmatic in the longer sense that it suggests active facilitation of a changing role for teachers in colleges or universities.

We should also be aware of the effects of the many research programs on colleges and universities entering a difficult period for locating staff. It is quite possible that too many teaching personnel may be drawn off into research efforts such as those of the learning-media research units.

5. Criteria for Location and Development of Centers

The location of the research centers should be determined by application of many of the following criteria:

(1) The availability of competent research personnel working in the area.

(2) The centers should be located in an area that is the scene of many of the problems to be investigated, for instance, a major urban metropolitan area having particular difficulty in industrial redevelopment or urban renewal.

(3) If an urban area is selected, it should have an active redevelopment agency working on some of the problems other than schools for the area.

(4) Agreements should be obtained before establishing the center regarding general relationships with public and private schools in the metropolitan or regional area.

(5) One or more centers should be established to investigate the rural end of the rural-urban continuum. In a sense, information handling devices can perpetrate as large a revolution in the rural area as in the urban areas. However, most of the centers should be in urban areas because a preponderence of our population will continue to live and work in urban areas.

(6) Centers should be located where there exists some possibility that local financial resources could pick up a portion of the research or follow-up effort.

(7) Adequate production centers for television, motion picture, and other media programs should be available within the immediate area. These production centers could be established only at rather heavy cost unless they are already in existence. A cooperative working relationship with these centers will be crucial in the development of tactics and strategies for using media.

(8) Some of the research centers should be put into environments that seem particularly resistent to changing programs. Since many of the problems to be investigated deal with the

strategies of change, it is important to investigate these in static environments as well as in environments which facilitate change.

(9) The location selected should be one that provides adequate, rapid transportation and communication facilities. This would include facilities for Data Phone, transmission of electronically stored information, etc.

(10) The location selected should be one in which qualified researchers would want to live and work. Reasonable housing and community facilities should be available for staff members.

The numbers of centers to be established should not be finally determined in the early years of this research program. If two or three pilot centers can be launched in 1962 or 1963,then people working in these centers could assess whether or not other centers may be needed. A good deal of time should be spent investigating the facilities of a local area before the establishment of centers. The staffing of a center might take a matter of a year, two years or even longer before a proper organization could be put together.

6. Financing of the Centers

At the moment, it seems that the centers should be financed in full for the first few years of their operation. After a certain number of years, a system of declining finance for the centers might be initiated so that the local community could gradually pick up some of the charges associated with the research effort.

The initial and even much of the eventual financing will continue to be found either at the level of the Federal Government of within the larger private foundations. The duration of such financial efforts by these organizations should be clearly indicated to cover a number of years. The research centers should clearly build to be at their peak effort within a five-year period, perhaps tapering off to a sustained level at about the tenth year. The proposed attainment of a ten-year level of activity should be predicated on the idea that local finances would support the activity that still existed at the ten-year mark.

As more and more school districts and colleges and universities move into instrumentation of the educational process, more need for consultation and advice will be evident in each of these institutions. This need may be expressed as an unwillingness to pay for consultation and guidance in these areas. One of the activities of the center should encompass this type of service to surrounding communities.

7. Summary Statements

It should not be difficult to justify a greatly expanded program of research effort dealing with applications of technology in the educational process. Out present systems of education have expedited the technological revolutions of recent years, yet these very systems are among the last institutions in our society to benefit from technological advance. Industry and the military have advanced through use of information and storage and retrieval mechanisms in their operations; but, use of these mechanisms in schools is practically non-existent. Yet, information handling is one of the major businesses of the educational process.

We have only recently achieved the kind of information storage and retrieval mechanisms necessary to handle the problems of education of individuals. Yet, we continue on a mass-indoctrination base as a framework for operating our educational system. This mass base of operations may no longer be required if we make intelligent use of modern information storage and retrieval mechanisms that will allow individuals to learn at their own pace and to select those experiences which are most important to them for learning.

No aspect of the national welfare is more crucial than the problems of education in urban areas. A tremendous majority of our population will live in urban areas in the forseeable future. Many of these people will be displaced from the jobs for which they are trained by new technological developments. The physical facilities of the center city are deteriorating at a more rapid rate than they can be replaced by even today's great redevelopment effort. Redevelopment of the city contains problems not only of physical rebuilding but also problems of human re-education. Human beings must be re-educated to perform new jobs in a new society. We cannot consign the inhabitants of the center city to the scrap-heap. This we will continue to do unless we retrain these people for useful social functions when they have been displaced by technological development from their former positions.

To know, as we now seem fairly certain, that any of the media of communication can be used for learning is small comfort. We must, at the same time, know exactly what strategy or tactics we should use in preparing program materials for the media. Nearly all tactics of use of media up to the present time have concentrated upon the use of media in ways much like the behavior of the teacher in the classroom. Obviously this is an inadequate concept of media usage.

APPENDIX 1

RESOURCE MEMORANDA

EDUCATIONAL MEDIA RESEARCH CENTERS

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I shall limit myself in this memorandum to a single problem of educational research -- the nature and uses of the written word. Let me remind you at the outset that it is a topic that is at the heart of the education process and that the nature of written language is only dimly understood and that the nature of reading is even less well comprehended. In view of this critital state of ignorance, it is the more surprising that there does not exist a single major research center in the United States addressing itself directly to the study of written language, either from the point of view of its encoding process in writing or its decoding process in reading. This is not to say that there is not scattered research to be found around the country dealing with the teaching of reading or the remedial care of slow readers. There is work going on in these applied fields, but it is without benefit of a corpus of fundamental research on the very nature of writing and reading as psychological processes. Where exceptions exist to this state of affairs, as in the beginning work of Hockett's group at Cornell, or of Richard's group at Harvard the effect is to leave one the more puzzled. For the research just barely in progress seems to be full of interesting openings -- as in the effort to isolate the distinctive features of written speech so that the graphemes in terms of which letters and words are distinguished one from the other can be discerned.

The background of the present neglect is instructive and encouraging. Linguists have not generally interested themselves in written language. Their emphasis has been on spoken language, and for several reasons. In the first place, the comparative method of linguistics required the study of many languages that are "pre-literate" in the sense of having no written transcription. Attempting to generalize the "design features" of human language, one could only make things complicated for oneself by taking into account the range of graphic representations - - from non at all, to pictographic and ideographic representation, to the use of syllabaries and alphabets, on to the formalized and compact symbolizations as mathematical notation. And perhaps in its early stages it was just as well that "modern" linguistics ignore temporarily the vexing problems of encodement and decodement of spoken language in graphic form. For there has been a huge surge forward in past decades of our understanding of the nature of spoken language, its development, its phonemic and morphemic nature, and the combinatorial means whereby language is generative or productive of utterances beyond those one has previously encountered. There is little question that the progress of structural linguistics has been nothing short of revolutionary in the past quarter century and names such as deSaussure, Troubetskoy, Sapir, Whorf, and Jakobson can be paralleled today by those of younger investigators who have brought new and powerful formalisms to bear on the study of language. In a deep sense, it can be said that linguistics is now ready to tackle the problems of written language.

Other parallel developments suggest that the moment is ripe to begin a concerted attack on the study of written language. One such development is in the theory of computation. Efforts to construct programs for the recognition of written language by computers -- the work of Selfridge and Neisser at M.I.T.'s Lincoln Laboratories, to take one example -- have highlighted several interesting features of letter recognition. Similarly, automatic or machine translation has led us to examine the nature of the written "unit" that is to be taken as carrying a translatable or decipherable message.

Another development is to be found within psychology itself. A generation ago, the peripheralism of psychology, its emphasis on "connecting" stimulus and response downgraded the importance of and interest in those activities of human beings that we now think of as "information processing". The impact of information theory, of computational programming theory, and of linguistics on psychology has been to quicken the interest of a new generation of psychologists in the cognitive processes. With renewed interest has come a new technology of research that, in my view, has an especial relevance to research on written language.

Finally a word about the more practical side of the question. There have been periodic studies published on the nature of reading, on the teaching of reading to adults and children alike, on the design of literacy programs, and the like. UNESCO's efforts in the field of basic literacy have led to the publication of monographs summing up the state of the art. In connection with the work of the U.S. AID program and the enterprises sponsored by the Asst. Secretary of State for Education and Culture, world famous linguists have been brought together to consider the nature of reading and its teaching. The Soviet Union has also published considerable material on literacy training. All of this work points squarely to a lack of information about the basic processes involved in reading -- how the reader moves, for example, to an encodement of single letters to words to phrases to a "sense" of a message taken in by a quick scan. The very work on eye-movements that is available is, to a student of visual perception, embarrassing in its poverty of conception and its crudeness of execution. Reading specialists are still talking about eye-movements along a line of print as if the eye in fact obeyed the printer's font all the time. I could find no study in the literature describing the manner in which the eyes scanned when a person is passing his eye over a page to find out what a passage was about in as short a time as possible. Nor can I find any study of the relation of eye-movements to the grammatical structure of written materials.

The systematic study of written discourse is again almost non-existent. Sir Frederic Bartlett's classical study of remembering, analyzing the nature of change in the memory of a story heard earlier has never been paralleled by a study of what happens linguistically at different ages when a person translates a spoken discourse into written representation immediately. The rules of translation from spoken to written language are unknown. We do not know the difference between going from "thought directly to writing" and going from "thought through speech to writing." Again, this is not to say that there are not scraps of information in the scattered literature, but only to comment upon the paucity of systematic knowledge available to us for guiding our pedagogical and remedial efforts.

A Proposal

It is urgent that there be established a Research Center on Graphic Linguistics to be devoted exclusively to the study of the elementary processes of writing and reading. Such a center should be concerned exclusively with matters of basic research and not with the evaluation and testing of pedagogical applications of linguistics findings. Its fundamental orientation should be toward three basic questions:

What is the nature of written language?

What is the nature of the encoding process whereby "mental content" and "spoken language" is translated into written form?

What is the nature of the reading process whereby a person decodes graphic language?

The component skills to be represented in such a Research Center are various. Linguistics, computational theory, psychology, anthropology, communication theory, and educational research should be represented -- as well as such technical specialties as neurology, visual physiology, etc. as needed. The Research Center must be located at a place where the component specialties are strongly represented, for much of the work will require consultants from fields that cannot find full-time representation in the Center. This requires location at a major university center where work of all the kinds mentioned above is in full progress -- from computation to the neuropathology of aphasia.

There are relatively few such university centers in the world today. I do not wish to plead for the area of Cambridge, Massachusetts, but the presence there of the combined resources of Harvard, M.I.T., Brandeis, several medical schools, the Lincoln Laboratory, as well as the talents of such people as Roman Jakobson, Noam Chomsky, Eric Lenneberg, Roger Brown, Oliver Selfridge, Ulric Neisser, George Miller, Maurice Halle, John Carroll and others make this seem like an ideal research setting.

In considering financing, it seems apparent that a Center such as described here will cost in excess of $ 500,000 per year. A staff of 15-20 senior investigators with supporting technical, clerical, and instrumental aids, plus consultant assistance is moderately costly. There should also be established a system of pre- and post-doctoral fellowships for the training of research workers in this critical area.

The Center should be directed by a man distinguished for his research leadership in some aspect of the field -- be it linguistics, psychology, or communications theory. I would expressly exclude from the directorship, at least at the start, a professional educator since the task for the first part of the Center's life at least will be one of mounting a major research effort.

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As I consider the range of basic research that is needed to support the sciences of education, I can think of none that is more important than the study of written language -- or graphic linguistics, as we have called it here. There has not been a major breakthrough in the graphic representation of language since the technique of placing the printed alphabet on a page, and even that was a copy of the handscript technique developed more than a millenium earlier. Nor have we gained much understanding of how to ease the task of the person faced with a page of print. It is estimated that considerably more than half the world's population is illiterate and that few even begin to approach maximum efficiency in reading.

If we are to move from our present state, we shall need the basic research that makes clearer what a written language is and how it can be most effectively used.

LEARNING RESEARCH CENTERS

Kenneth W. Spence

University of Iowa

(1) Concept of Regionality

I believe that the idea of a research center for a region is a good one. A number of the Big Ten schools have tried it out in one or two areas and from what our Dean says it has worked well. The one area that I know of in which it is being tried is Classics. - Whether one can extrapolate from this area to psychological research is a question.

My main argument for trying the idea is that it might help to combat the provincialism that exists in the field of psychology, especially in the field of learning.

. . . .

I believe that the regional concept would lead to graduate students getting exposed to more different viewpoints taught with the vigor that proponents tend to exhibit.

(2) Areas of Research

I would think of there being a variety of different kinds of research centers and institutes. As you know, Postman has set up a Center at California that is primarily concerned with human verbal learning and higher symbolic processes. If we were to establish a center at Iowa it would likely be a little broader -- ranging all the way from simple conditioning research to the study of motivational factors in complex human behavior. The address I gave to the APA for the Distinguished Scientific Contribution Award gives some idea of the range of interest and interrelations between them of my own research in learning and its motivational basis.

In the center we have been thinking about, we also plan to have a division concerned with programmed learning research.

We believe there is a great deal of basic research that needs to be done in this area that has first to be carried out in the psychological laboratory and not in the classroom.

(3) Relation to Academic Institution

I am one of those who primarily believes that Research Institutes should be set up in close conjunction, physically and intellectually, with universities. I would go further and say with a university department or group of departments. My strong convictions on this point are based on my observation that very few scientists continue to be very productive if they cut themselves off from graduate student teaching (seminars, etc.) and thesis research direction. I know there are a few exceptional instances -- however, I cannot think of any in our field at the moment.

We envisage our own research center as being a part of the Department of Psychology with the staff having their academic appoints in the Department. However, the members of the Center would be budgeted separately. Some might be half and half, but at least one or more would be budgeted full time in the Center. The Center would also have its own research budget. We hope to provide new space by an addition to our present building and it is our plan that the Center will be housed in this building.

(4) Size of Center

I do not have any view on the size. I think that the type of center which is closely related to an academic department should not be too large. We envisage at most three full-time appointments and two part-time appointments. In addition to this, we would like to have two to four slots for temporary appointments (1 to 2 years). The size of such academically-tied research centers would probably to some extent depend upon the size of the department with which it is associated and the number of graduate students it could attract and support.